AMERICAN
STATISTICAL ASSOCIATION

NEW SERIES, No. 111. SEPTEMBER, 1915.

THE SOCIAL SURVEY AND ITS FURTHER DEVELOPMENT.*

By J. L. Gillin, Ph.D., *Department of Sociology, the University of Wisconsin.*

Never has the world seen such a passion to apply to society the aphorism of the ancient philosopher, "Know Thyself" as we find rising in the communities of today. Statistics of some sort the world has had for a long time; statistics concerning the things about which we are gathering information today, however, until recently have been very few if not entirely lacking.

Never as now have men put the test of efficiency to political, economic, and social movements and agencies. In business, cost of production and distribution cannot longer be ignored or guessed at; they must be known. Thousands of dollars are spent by business and industrial firms every year for advice as to how the wastes of the business may be eliminated. Business organization is judged by its success in so coördinating the forces it employs that there may be the minimum of friction and waste. The efficiency movement, so-called, has produced remarkable results in commercial and industrial organizations.

The social survey is an expression of this same movement in the social as distinguished from the economic realm. The social survey is an endeavor to take stock of certain phases of the community which bear upon that community's welfare. Its methods have been borrowed, to begin with, from the commercial world in part, and in part from the methods of the census. The first great social survey of modern times was that of Charles Booth, in his *Life and Labor of the People of London*, on which he spent many years and a great fortune. It is the

* Paper prepared for the Annual Meeting of the American Statistical Association, Princeton, N. J., December 29, 1914.

most comprehensive social survey that has ever been made by a private party. The one great survey made in America by a private organization is the Pittsburgh Survey, which is not entirely published at this date. The movement has gained impetus in America by the establishment of a Department of Surveys and Exhibits by the Russell Sage Foundation, and by reason of the publicity that has been given to the results of the surveys of various magnitude in different parts of the United States. It has become almost a fad to start a social survey. Because of this popularity the survey is in danger of becoming a by-word and degenerating into a pleasant pastime for otherwise unoccupied people. On the other hand, this belief in social stock-taking supposed to be secured by the social survey, has made possible the rise of a group of professional surveyors who are endeavoring to commercialize this passion for social knowledge. These two vagaries, however, must not blind us to the possibilities of the social survey to contribute to community improvement.

Varieties of Surveys.—Social surveys vary first as to the scope of the survey and second as to the persons who may properly make the survey. The scope of the survey depends upon whether it is a survey for a small community or for a large one. It is very much easier to make a thorough-going survey of a small, simply organized community than of a large one with its complex interests, its interlocking organizations, and its immense diversity of population, economic activities, and social functions.

In the survey of small communities the effort may be to make a rather rapid preliminary survey that will produce an appreciation of the problems of the community. Such a survey can be made easily and cheaply and will serve as a working basis for a more intensive investigation of some of the significant problems discovered. On the other hand, a social survey may be a very complete investigation of the various interests, activities, industries, organizations, and phases of community life.

For the large community the social survey may take any one of a number of different forms. As in the case of the small community it may consist of a rapid, rather superficial kind

of social prospecting, confined to certain neighborhoods of the community. The purpose of this survey would be to provide a cross-section of the community life. Or the survey may be a wider investigation, but not intensive, taking in perhaps the whole community preparatory to a more complete study later. Or, it may seem best to make a complete survey of the whole city, based upon a preliminary survey by paying special attention to those phases of the city's life which the preliminary survey has shown to be of chief significance. The best example of this type is the Pittsburgh Survey. Or again, the survey may be a community problem survey. In this case, the investigation is confined to one or more specific problems in the community, such as health, recreation, sanitation, industry, etc.

The surveys differ from each other also with regard to the persons making the survey. An investigation of a community may be made by experts trained for such work. In that case the whole of the investigation would probably be made by parties from outside the city. Again, the survey may be made by certain interested persons in the community itself, under the direction of an expert. Or again, the survey may be made by certain people in the community on the basis of an outline and printed or typewritten plan prepared by experts.

Each of these plans has its advantages and its short-comings. The expert from the outside possesses the advantage of no acquaintance with the intricacies of the local situation and he can go ahead without reference to any existing prejudices. On the other hand, he suffers the disadvantage of not knowing the local situation and therefore is likely to spend a good deal of time in finding out things that are matters of common knowledge to the people of the community. The second plan has the advantage of expert direction and of local advice and coöperation. If it has any disadvantages they are incidental to the difficulty of securing coöperation between the people of the community being surveyed and the experts in charge of the work. The third plan has very narrow limitations. It cannot be used at all in large, and for only very superficial work in small communities. This method, however, serves as a possible beginning in community stock-taking, and, pro-

vided it is very carefully done, is a useful device to get people interested in a careful study of their community.

Further Steps.—The social survey has now developed to the place where it is manifest to careful observers that some further steps in its development are necessary. Certain short-comings have been complained of by its enemies, and certain others have been recognized by its friends. The difficulties of the social survey are incidental to its growth.

1. Some adaptability to the needs of various communities is now to be found in the methods of the social survey. It varies, as has already been indicated in the first part of this paper. It is felt, however, that it must be further perfected in its adaptability to the varying needs of different places and situations. The plan of a survey adapted to a small community, of course, is not adapted to a large community; neither are the methods used in making an intensive survey like those adapted to a "prospecting survey." Yet, for reasons that will be mentioned later, it is desirable that there be sufficient uniformity in the methods used for varying situations so that the results may be compared with exactness.

2. It is desirable also, that there be an improvement in the standards and units of measurement used. The technique of the survey must be further perfected. Through long experience civil and mechanical engineering have established certain standards and units of measurement which are generally recognized by all investigators in these lines. So, also, the good diagnostician has certain fundamental things concerning which he inquires in his endeavor to ascertain the causes of disease. Likewise, there are gradually developing among social surveyors certain standards for the measurement of social phenomena. These standards, however, differ somewhat from man to man, and there is lacking that agreement among social surveyors which is highly desirable. Moreover, as Miss Goldmark noticed a number of years ago, it is highly desirable that a unit of measurement in each class of phenomena investigated be more widely recognized than at present. The difficulty with the present diversity of units of the phenomena investigated makes it impossible to collate the results of different surveyors for purposes of comparison. Thus the develop-

ment of the technique of social surveying is one of the pressing needs just now. It is not intended that any hard and fast rules be laid down that shall hinder experiment at a time when social surveying is in its infancy. It is desirable, however, that those who are concerned for the perfection of the technique of social inquiry and who have had most experience in the gathering and handling of statistical data bearing upon social affairs should bring to the solution of this problem their intelligence and experience for the benefit both of the communities surveyed and of the scientific results to be obtained by the collection and comparison of data from widely different areas of our country. On the fundamentals there could well be agreement, even if there is diversity of opinion as to some of the details. The time has come when it is highly desirable that upon the fundamentals of the survey there should be general agreement, and that a body commanding the respect of students in the various fields of social phenomena should back up these standards with its prestige.

3. Incidental to the wide value which the social survey has begun to enjoy is the growth of a commercialized professionalism. Once the technique of surveying is established in a general agreement among those interested in such problems, doubtless the commercialized professional social surveyor will serve a useful purpose, just as the public accountant, the civil engineer, and the doctor occupy positions of honor and usefulness in our social life. Nevertheless, in the absence of established standards of survey work, the commercial social surveyor who depends upon his work for a living is a menace to the development of this method of social stock-taking. Now is the time to provide for the deliverance of the survey from the hands of the man who does social surveying on a commercial basis. Already in a number of our universities and colleges the social survey is established. Among these are the University of Minnesota; the University of Kansas, and the University of Wisconsin. Moreover, a number of private organizations are doing commendable work on the non-commercial basis. Among them are the Department of Church and Country Life of the Presbyterian Board of Home Missions and the Department of Surveys and Exhibits

of the Russell Sage Foundation. Besides these a number of the schools of philanthropy have devoted considerable attention to methods of investigations and supply training in social survey work. In special fields the Recreation Association of America, the Association of Societies for Organizing Charity, and a number of other bodies are doing survey work on a non-commercialized basis.

It is highly desirable that in the early development of this work the first consideration should not be the pecuniary return. The professional surveyor is likely to be open to criticism on a number of points. Too often he starts in on the social survey the victim of a pre-conceived hypothesis or of an established prejudice. He assumes that certain things are wrong. Unconsciously that conviction colors his findings. Having found certain things wrong in other communities, naturally he is looking for the same things in the community now under observation. Again, the commercialized surveyor is prone to look only for bad conditions rather than to make a correct appraisal both of the good and the evil in the community's life. He is likely to feel that he must find the evil that his employers have suspected, else he cannot justify his employment. In this respect he reminds one of the quack doctor who can secure business only by making out a bad case for the prospective patient. Such a surveyor may excite interest and secure employment for a time, but his methods are sure to bring reproach upon the whole survey movement.

Again, the social surveyor desires publicity for his work. He has learned that muck-raking secures publicity. Therefore he emphasizes the evil conditions in the community without stating them in their proper relations to the social assets of the community. Following the publication of a one-sided survey of this kind, there is bound to be a reaction on the part of those who know that the community is better than it has been painted.

Again, the commercialized surveyor, in borrowing the basic idea from the accountant and the shop efficiency expert, is prone to apply a yard stick to the measurement of ideas, to weigh the value of institutions with a clumsy steelyard, and to evaluate educational, recreational, religious, and other social

institutions by the standards of efficiency worked out in a business house or a factory. These clumsy methods and standards are bound to meet with rebuke. Who but a lop-sided social surveyor, obsessed by an idea half truth and half falsehood, can believe that the efficiency of a teacher, preacher, or a social worker can be measured by the same or even similar methods as those applied by the efficiency engineer to the foreman of a shop or the worker at a machine; or that the value of a social institution, such as a church or a school, can be determined by the number of services held in the former, or the number of hours spent in the latter? The social survey must result not merely in destructive criticism, but in a constructive program based upon a careful study of both the social assets and liabilities. Muck-raking in social surveying may have been a necessary incident to its development, but it is a question whether that necessary incident has not been also a necessary evil. Any community is justified in resenting the publication of its defects to the world unless its good qualities are set forth in as striking a manner. The ideal, of course, is that the good present should be made the basis for a constructive program to remedy the evils found. It is time that the various agencies at work at the present time on a non-commercialized basis should unite in their efforts to establish standards and methods for the social survey that will redeem it from the reproach into which commercialized social surveyors have sometimes brought it.

4. A still further step necessary to be taken that the social survey may fulfill its possible function in society is the standardization of methods so that the findings of the different surveys may be brought together for comparison. From the scientific standpoint it is highly desirable that the results of these various social investigations should be brought together in order that generalizations concerning our complex social life may be formed. Of course, the practical results of the survey are what is immediately desired by the community surveyed. Nevertheless, in the long run, the survey must provide a foundation of social fact upon which may be established principles regulating social life. Therefore, the next step is to provide for the collection and comparison of the

findings of the social surveys made in various parts of the country. To make these findings comparable, they must be secured according to uniform methods over standard units of area to be investigated.

5. If the contentions of this paper are correct, and I believe they represent the feelings of those who have watched the progress of the survey movement, then there should be organized a body representing the various groups of people interested in the social survey. This body of men should devote themselves to a study of the survey as it exists at the present time, suggest methods by which its defects may be removed, its technique perfected, and its results correlated for a larger purpose. The American Statistical Association, the American Sociological Society, the various private organizations doing survey work, and the colleges and universities should organize a joint standing committee on surveys and statistics to see that these steps are taken as rapidly as possible. So important an agency for the social welfare must not be exploited by selfish men for their own private gain in such a way as to destroy its usefulness. A standing committee formed from these bodies already mentioned should aim not only to report on what is being done in various parts of the country, but should formulate standards and methods on which all could agree in order to give advice and help to persons engaged in social investigations. In this way the coördination of the agencies already existing could be obtained in the great work of making the social survey of the greatest possible usefulness in ascertaining the facts touching our social life, in working together on a constructive program for community betterment, and in preventing the abuses which sometimes have grown out of ill-advised efforts at social investigation and community betterment. What good reason is there why such organizations as the great philanthropic and scientific foundations, the universities and colleges, important national bodies like the Statistical Association, the Economic Association, the Sociological Society, and perhaps representatives from such national bodies as the Federal Industrial Relations Commission, the Bureau of Labor Statistics, etc., could not coöperate in giving the social survey movement direction as well as impetus?

DATA ON UNEMPLOYMENT FROM EMPLOYERS' RECORDS.*

By Howard Woolston, Ph.D., *Director of Wage Investigation for The New York State Factory Commission.*

Mr. Chairman and Gentlemen.—In a busy office an inquiring statistician is as welcome as a skeptic at a revival, and is frequently consigned to the same fate—conversion or perdition. The firm may have established a system of records so complex that the junior partner cannot study the sporting sheet before noon, because of the reports that accumulate upon his desk. Or a recent lecture on efficiency may have so impressed the manager that he drives the book-keeper to profanity by requests for information upon man-hours, per capita output, inventory and depreciation. An enthusiastic business man at luncheon will bore you to exhaustion with details of discounts and commissions. But present yourself the next day with credentials from the state and ask for data from his pay-roll, and this same genial person fixes you with a cold stare and demands what plot of political burglary you are attempting to abet. It is like an unsolicited call from the doctor—a shock to the unwilling but not unsuspecting patient. In other words, industry generally does not wish to have its statistical symptoms made public.

As a matter of fact, the average business man is not directly concerned about the facts of *unemployment*, nor do his records immediately show conditions in this respect. He knows how many persons were *employed* in his factory at any given time and how many places are now vacant. But he could not tell you offhand how many different individuals have been taken on during the course of a year or what has become of those who have been dropped. Modern industry counts upon the possibility of hanging out a sign, "Girl Wanted," and getting a score of applicants. What happens to those who are laid off at the end of the season does not worry it overmuch. Employers are usually more interested in output and wages than in vagrancy and pensions. Relatives, philanthropy, or

*Address before the quarterly meeting of the American Statistical Association, Yale Club, New York City, April 17, 1915.

Merciful Providence are supposed somehow to haul in the slack. Business is business; not an asylum. So what do you expect?

Of course you know the appalling waste of this policy of keeping business clean by allowing it to throw its human refuse into the streets. You appreciate the social cost of permitting industry to scrap its useless personnel at the expense of the public. Some employers are also beginning to see that this is poor management, and are trying to organize a system for adjusting their human machinery, just as they have engineers to look after the management of the plant and its equipment. They are beginning to follow with care the records of their workmen and to place them where they can be employed steadily and efficiently. Indeed, efficiency seems to demand steadiness, for a temporary worker loses speed, deftness, and ready judgment in handling material.

How great the loss from disorganizing a staff of workers and breaking in new hands may be, we do not know. The extent of seasonal fluctuations and individual shift have been discovered. For instance, the Factory Commission found yearly variations of 30 per cent. and 40 per cent. in the working force of comparatively steady industries in this state. Twice as many workers are added and dropped annually by individual firms as are usually employed. This displacement is more serious than the figures suggest, because only about one fifth of the workers are steadily employed throughout the year, while more than one half of all remain with the same firm less than three months out of twelve. Of course this shifting about involves loss of time between jobs. Out of 1,500 women interviewed regarding this matter, 1,000 had lost time during the preceding year. This amounted on the average to more than one month for each of them.

These figures indicate some of the data that can be obtained from the records of employers. One of the most profitable sources of information in these matters is the register of employees kept by some firms. In the better establishments this is generally in the form of a card catalogue, containing the main facts presented on the application, such as the name, address, sex, age, birthplace, previous experience, and former

employers. To this information is usually added the date of engagement, department or occupation to which the person was assigned, rate of wages on beginning, together with subsequent transfers, and date of leaving with reasons therefor. Such files are mines of information regarding the industrial history of workers, their advancement, replacement, and the *steadiness of their employment.*

Unfortunately many firms do not keep an adequate register of employees. In some cases a factory hand is known only as "Joe," or "Number 539." The original number is frequently changed or the worker is shifted to another department without recording this fact. It is then almost impossible to identify "Joe" among three or four persons of the same name or to trace "Number 539" with any certainty that the same individual is being followed. I recollect an instance of a man in a Pittsburgh mill, who was absolutely volatilized by the overturn of a bucket of molten steel. His relatives sought compensation from the company. But his name was not opposite the number assigned to the dead workman. There were literally no remains to identify, and so the man simply disappeared—lost in the records of the mill.

Very often the home address given by employees is false or has long been changed. This frequently occasions misunderstanding as to living conditions or causes delay in receiving official communications. An outbreak of smallpox appears in an Italian lodging house where several hands in a local chocolate factory live. Records of the firm show no such address for any of its employees, and the questions of the visiting physician are answered evasively. The first intimation the cocoa manufacturer has that his workmen have been bunking next to an advanced case of the disease, is when, after a brief absence, one man yells because his neighbor has struck his recently vaccinated arm.

It seems very important that every employer should keep a proper registry of all persons who work for him. This would insure correct identification of employees whose domicile, citizenship, majority, occupation, means of support, and past experience might be questioned, and for whom the firm might prove in some way responsible. Such a record is now required

for certain classes of employees, but it should be demanded for every worker in an establishment. This seems to be a proper measure for those of you who are interested in adequate labor statistics to frame and to urge. Certainly uniform records containing such information would greatly simplify the work of labor authorities in tracing industrial histories, and would enable them to know for a certainty who had been employed by a given firm.

In many cases the pay-roll is the only record of employees. It generally shows for each date of payment, the number of persons working and the earnings of each for the preceding period. This, of course, is our main source of information regarding employment. But the way these records are kept would harrow your orderly souls. Some are in the pocket memoranda of proprietors. In other cases a weekly sheet is made up and then thrown away. The better firms have beautiful loose-leaf books, showing opposite the name of each employee for a number of weeks the rate of wages, time worked or pieces turned out, additions, deductions, and total earnings. From such records one can readily follow the fluctuation in employment and wages.

Here again, it seems important that a body such as this should concern itself to secure the keeping of proper records. Without them, we can have no adequate statistical data. The matter of days or hours employed, or of output for piece workers, is fully as important for an understanding of the state of industry as is a figure giving the number of persons at work and their rates or actual payments. During a slack season half the workers may be on part time although nominally employed, or extra hands may be engaged for a few hours a day during a busy period. These facts would pass unnoticed in a general statement of total persons employed. I hope that some of you with an interest in scientific book-keeping will suggest a simple, uniform pay-roll, time sheet, and record of output that may be urged upon progressive employers.

But finally, the extent and causes of unemployment can never be studied properly until we secure uniform periodic reports from large numbers of employers. This, it seems to me, the state should require at short intervals in order to

supplement the work of the federal government. The general form used by the Census authorities or that required by the Massachusetts Bureau of Statistics offer good models to follow. Perhaps a statement of persons employed each week and total payments to the same would form a desirable basis. The addition of a simple classification of the number of persons receiving specified wages would enormously increase the information conveyed.

It is desirable also that such reports should give not only the number of persons employed at any time, but the number of individuals who have been added or dropped by the firm during a certain interval. This shows the fluidity of the labor market, which is quite as important as an index of its general rise and fall. In stock quotations we want to know not merely the current price, but also how many shares changed hands at that figure. In weather reports we ask not only the barometric pressure but also the direction and velocity of the wind. So in labor reports we should be able to find not merely how many workers have jobs at a given time, but how long they can hold the jobs.

Through the active interest of a group such as this, adequate returns from employers as to the state of their business might be secured. Many men of affairs would welcome a thorough-going study of the labor market and would do their part to make it possible, if they were assured that the returns would be dealt with in a strictly scientific manner. Employers now resent the duplicate demands of several authorities, and view with suspicion the efforts of any administration to investigate the details of their business. This unwillingness to submit to what is termed "political interference" may be justified, since one administration may establish a system of returns and the following one may reconstruct the whole plan. If, however, a national body of scientists and practical men would establish standards and insist upon their being followed, much of this unwillingness to supply information would be removed.

The federal government has already done much to secure the coöperation of representative firms throughout the country in this matter of reports upon business conditions. The

states have not all been equally successful. But if their work could closely follow that of the national authorities and articulate with it, there is no reason why the country might not be covered with a net-work of centers for gathering accurate and timely information.

You know how the system of labor exchanges in Germany was established largely through the efforts of a few men who gradually brought together various agencies throughout the Empire. With the help of the national and state authorities represented in this society, there is no reason why we may not hope soon to organize a scheme of intelligence bureaus that will cover this country. Their bulletins of information for each region will soon become invaluable to large employers of labor, who will study them as carefully as the quotations of the produce exchange and the statements of the banks. For labor, after all, is the most important single factor in business; and once business men have learned that the movements of the labor market can be rationally followed, predicted, and controlled no group in the community will be more eager to help in the adjustment of its problems than the fair-minded employers of America.

But the problem of unemployment is too difficult for any class in the community to deal with out of hand. We have long since ceased to hope that passing the hat and taking up a collection for the man out of work will serve as a solution. The relief funds of charitable agencies and trade unions can not sustain a growing number of dependents at times when their contributions fall off. It is useless to ask employers to furnish additional jobs when their business is inactive. And by a bitter irony of fate, the administration cannot undertake public works because its resources also are straightened during periods of industrial depression. Here, then, is a desperate situation that recurs with increasing acuteness. What can be done?

This appears to be a problem of the sort that an actuary tackles when he calculates the cost of insuring during periods of productivity the lives and health of men who are bound to fall ill, grow old, and die. The business world must somehow be brought to distribute and adjust the burdens of adversity during its periods of prosperity.

But what actuary would attempt to fix any insurance rate without careful study of the experience of large numbers of cases at risk for long periods of time? Here is where the statistician must help by collecting a sufficient body of reliable data. And who are better able to furnish the facts regarding the cycles of trade than employers, whose demand is the stimulus of the labor market?

When these men can be brought to see that by pooling their experience they can furnish the basis for a scientific solution of this problem, I believe they will not be slow to do so. And when, as a plain business proposition, they understand that lessening unemployment means lowering charges upon industry, I am sure they will take rapid and effective measures to bring order and regularity into the erratic and irresponsible conduct of their fellows.

THE VALUE TO ECONOMICS OF FORMAL STATISTICAL METHODS.

By Carl J. West, Ph.D., *Ohio State University.*

To afford an accurate form of summary statement of economic facts and changes, statistics must present the facts in such a way as to enable the mind to grasp them as a whole more readily and clearly. From this point of view the chief care of the statistician is to secure accurate and comprehensive field-work or counting. As a recorder and tabulator of economic data he can consider his work done either when each individual instance has been enumerated or when a definite estimate can be made of the per cent. of accuracy.

But economics demands that statistics do more than serve as a sort of bookkeeper. It is only by a study of the statistics that causes and relations can be suggested and the basis laid for empirical laws. The complexity of our economic relations requires the economist to keep in constant and close touch with concrete facts.

To what extent the prevalence of a certain disease depends on the climate or the season and to what extent on the state of sanitation can in general be determined only from an extensive statistical investigation. The intricate questions concerning the rise and fall of the interest rate are largely matters of dependence among different series of statistical facts. A general theory of prices and the gold supply needs empirical verification at every point. The fluctuations of wages and the movement of retail and wholesale prices can not be adequately understood until better and more accurate data can be obtained. Immigration and business prosperity and depression, the consumption of alcohol and the presence of poverty are essentially questions of the effect which variations in one condition or characteristic produce in related attributes or conditions.

These illustrations suggest the rather evident fact that the logic of most problems in economics is essentially the same. The ultimate aim is of course to detect and demonstrate causal

relations. The limitations or requirements of the problem may render it undesirable to attempt a more detailed formulation of the causal statement than of the type: If cause or event A is present then effect or event B will follow; or negatively, since A is not present or does not vary when B varies in value or degree of intensity, A can not be the cause of B. In general, however, the description of the causal relation can not be considered satisfactory until it is possible to state in detail just what change in the effect will follow from certain definite changes in the cause. Thus causal relations fall naturally into two broad divisions according as the characteristics or attributes are accurately determined and measured in detail, or are not measured further than to enumerate the cases in which each is present or absent.

For the purposes of statistical economics, characteristics or occurrences may be said to be causally related when, *other things being equal*, the presence of a definite amount or degree of the one is always accompanied by a corresponding amount or degree of the other; so that, in general, if one changes the other changes and if one is present and acting, a corresponding effect is to be noted in the other.

The physicist, the chemist or the engineer can make direct use of this definition since it is often possible, within working limits, to hold all other conditions constant while the conditions under consideration are varied. The engineer can so arrange his experiments that discordant and irrelevant elements can be avoided, as, for instance, when the distinct strains that a steel beam undergoes are reproduced in the laboratory and the effects measured.

But the material of the economist in degree, at least, is radically different from that of the student of the so-called exact sciences. The data of the former is always heterogeneous and complex so that it is not possible to isolate the variations and observe their relations directly; neither can it be safely assumed that all other conditions are constant while the conditions studied vary or change. For these reasons the comparatively simple and direct methods of those sciences will not apply to the solution of the problems of statistical economics. The social scientist requires methods for discovering and

demonstrating the presence of definite and uniform *tendencies* for variations in one condition or characteristic to depend on the changes in certain other conditions; that is, *correlation* methods which deal with measurements *en masse* rather than as individuals.

Thus, to test the obvious fact that during the earlier years stature increases with age, the height of 1,000 individuals at ages ranging from 6 to 25 might be determined and the average height for each age computed. In the midst of the disconcerting variations due to lack of homogeneity in conditions of health, parentage, environment, posture, etc., the general tendency for tallness to accompany heaviness would be apparent in the data.

For the treatment of the essentially *mass-aggregate* or *group* problems of *statistics* which have to do with collective and not with individual measurements, a body of theory having the definite and systematic form of the other mathematical sciences has been developed. Owing to its having been first developed for the problems of biology, however, there is need in some respects for adaptation to the requirements of the social sciences.

Every economist who makes use of concrete statistical facts must form collective judgments, must rely largely upon correlations to point out causal relations regardless of whether he consciously and formally makes use of the terminology and methods. As an illustration of a simple type of question which can not be answered by the use of informal methods take the following data of the Sheffield smallpox outbreak of 1887–1888 as given by Dr. Macdonell:*

VACCINATION–STRENGTH TO RESIST SMALLPOX WHEN INCURRED.

	Recoveries.	Deaths.	Total.
Present	3,951	200	4,151
Absent	278	274	552
Total	4,229	474	4,703

This table shows clearly that in this instance vaccination was highly effective in combating the disease. But sup-

*Elderton, *Frequency Curves and Correlation*, p. 125.

pose the same statistical material were reclassified on the basis of the presence or absence of a characteristic which we may call "sanitary" and that the following distribution was obtained:

"SANITARY"–STRENGTH TO RESIST SMALLPOX WHEN INCURRED.

	Recoveries.	Deaths.	Total.
Present	3,850	195	4,045
Absent	379	279	658
Total	4,229	474	4,703

Apparently this measure or condition is about as effective as vaccination so that it is a matter of careful study to decide which has the higher efficiency; no casual method can be relied upon to yield a satisfactory answer.

The inadequacy of informal methods may be further illustrated by the difficulty of properly "smoothing" a series of measurements by generally loose methods. To know what variations are accidental and what are significant requires first of all a thorough knowledge of the data, and to successfully eliminate the irrelevant or accidental elements without sacrificing the truly significant variations considerable skill in highly technical methods is necessary. The following table of the measurements of stature of a class of students furnishes material for an illustrative problem in "smoothing."

Stature	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
Frequency	1	2	2	11	11	48	45	97	100	126	103	97	45	46	4	1

In these measurements one would suspect for instance that the comparatively large numbers having stature of 72 and 70 inches were not significant. The equal frequencies for 62 and 63 inches are also to be noted.

Economists have done little "smoothing" or other refining of their data for the reason that *they have not attempted to utilize more than a very small part of the information it might be made to yield.* Were it the object of this paper to discuss the value of individual methods and processes the idea of the "probable error" and of the various measures of correlation

would be illustrated. But enough has been given to show the general value and especially to suggest what is doubtless the most important value of formal methods for economics: *that if economics is to make use of more than the most obvious statistical facts and relations it must employ methods adequate to the bringing out of the significance of the data.*

It is not meant to imply that an elaborate formula is always or even ordinarily essential to the demonstration of a conclusion in statistics. But the statistician and economist should be acquainted with the general methods in order to obtain the advantages of sharply defined technical concepts and of systematic and generally accepted habits of thinking and ways of attacking a statistical problem. Only then can it be correctly decided, for example, when the most superficial methods of estimating causal connections are sufficient; when graphic methods give results with all the accuracy that the data warrants or the problem in hand demands; and when it is advisable to employ more detailed and exact methods. *Thus the economist has need for a science of statistics similar to the need of the biologist for chemistry and microscopic technique and of the engineer for physics and mathematics.*

An extensive employment of statistical data means that the material must be collected as representative or typical data and not by complete enumerations. The expense and labor involved render the second method prohibitive, and besides few objects of economic inquiry lend themselves to the process of complete enumeration. Indeed, much can be said in favor of the argument that better data for the purposes of economics can be obtained by carefully selecting the material. Moreover, though the data may be gathered by an exhaustive process of counting it must be considered as typical, as a true pattern of what may be expected to occur again and again under similar conditions, if it is to be of value in establishing a principle or verifying a deduction. Reliable and effective work with typical data can not be done without an extensive acquaintance with statistical theory. For this reason, if for no other, statistical economics can not be developed to a significant extent until methods adapted to its peculiar needs have been worked out and popularized among economists.

It may well be asked what effect the introduction of more formal methods may tend to have on the quality of the empirical work of economics and on the effectiveness of economic work in general.

Accuracy in the collection or production of statistical facts and accuracy in determining and stating the degree of confidence that can be placed in the data is a matter of fundamental and vital importance for economics. The statistician who realizes how little has been done in this respect and how difficult it is to secure proper appreciation of the necessity for extreme carefulness and caution in accepting statistical material may well feel apprehensive of the effect of the introduction of new and apparently easy methods of deducing striking results. Perhaps the most suggestive way of estimating the probable influence of the extensive adoption of statistical methods on the quality of the data is by studying the conditions which somewhat similar circumstances have produced in other sciences. It is also of interest to note the working relations that have gradually grown up between the experimental and empirical elements on the one side and the so-called theoretical parts on the other.

The development of profound mathematical methods in physics has not tended to lessen the accuracy of the laboratory work but to increase it. On the somewhat slender basis of Hertz's experiments, Maxwell produced his mathematical theory of electromagnetism and ether waves. On the basis of and as a result of this theory, Marconi invented the wireless telegraph. This working together of theory and experiment along with the feeling that no result can be accepted until it has received both theoretical and experimental verification is of definite and positive significance for economics. If the two aspects can get on so well in the field of physical science, why not in the social sciences?

Psychology is similar to economics in that it deals with data subject to large variations in the individual measurements so that only aggregate methods can be employed. There is much discussion among psychologists regarding certain points of method, but it is generally agreed that experimental results must be reduced before they become completely intelligible.

An important consideration from our point of view is that the introduction of somewhat complicated methods for determining correlation and variation has stimulated both the production of experimental data and the critical discussion of such data, which can but result in better and more accurate experimental work. Moreover, the results in psychology tend to show that not only is the accuracy of the observational work increased but also the science itself is greatly enriched by the introduction of formal methods of reducing the statistical data.

The history of biology since the time of Darwin is especially instructive. Darwin, both by his example and by the stimulating influence of his work, gave great impetus to observational methods in biology. The researches that have resulted consist essentially of studies in the comparative variations among different biological classes and of the inter-relations of such variations. These variations are often small so that appropriate and adequate methods of dealing with the peculiar problems of the data are imperative. Professor Pearson in his "Mathematical Contributions to the Theory of Evolution" developed the working rules and principles which have been almost universally adopted by statistical biologists. Since so much of this statistical work is largely routine in character the results have been satisfactory on the whole even though few biologists have the mathematical training to understand the formulas.

However, the extensive employment in this mechanical fashion of highly developed but little understood methods very naturally has resulted in mistakes which if not so serious would be ridiculous in some instances. Using six- or seven-place logarithms with data subject to a high per cent. of error; smoothing curves by methods involving an overwhelming mass of arithmetic when a better curve could be obtained by simple graphic means; failing to realize that the "probable error" is a safe guide only for homogeneous data; losing sight of the necessary limitations of the theory of the coefficient of correlation, are only a few of the statistical sins which some biologists have committed in the name of scientific methods.

Aside from the useless expenditure of labor, computing to

so much greater length than the data warrants would not be a matter of great concern were it not for the fact that such a show of accuracy is often positively misleading. The wide margin of error in the original data is presently forgotten and the results taken with all their apparent accuracy.

A class of scientists trained, as are the biologists, in systematic thinking would not be guilty of such loose reasoning if they thoroughly understood the methods they were using. Nothing but mere routine and that only when done under immediate and responsible supervision can be safely trusted to persons with inadequate preliminary training. The statistician should not make use of a formula or method until he thoroughly comprehends the assumptions on which it is based and until he knows the conditions and limits of its validity. *And further, a formula should not be used unless the results derived by it can be clearly interpreted in terms of the initial data and conditions.* The biologist and economist can safely call upon the mathematician to derive the formulas which make it possible to pass from the raw data to the finished result, but the mathematician can not always be trusted to estimate the accuracy in the raw data themselves or to tell what formulas are the most appropriate under the given circumstances; this absolutely essential part can be done only by one who is thoroughly conversant with the statistical material and who has at least a reasonably comprehensive idea of the methods.

Thus the effect on the scientific character and value of the inductive or experimental work in those sciences in which there have been applications of formal statistical methods seems to give no ground for a fear that the quality of the statistical work in the social sciences will be lowered by careful and systematic use of more standardized methods. Aside from the support which a study of the history of the other sciences may lend to this conclusion, it is logically sound to expect that the character of statistical work will improve as more attention is given to technical principles. It is only by the building up of a body of systematic principles and methods that a subject of study can be raised to the dignity of a science. The mere fact of the existence of formal methods imparts a definiteness which tends to stimulate systematic thinking even though

the actual methods are not consciously or formally made use of. Besides there is always a gain in doing routine and detail work according to orderly, systematic, and generally accepted methods. For instance, the consciousness that the methods employed have been tried and proved produces a confidence in the results which can be obtained in no other way. The too frequently encountered opinion that one "can prove anything by statistics" is due partly to the lack of generally recognized methods of measuring the degree of connection between related series of events, and partly to the failure to critically value the reliability of the data, and much of this failure is due to the lack of simple but uniformly applicable methods of measuring such reliability. The non-technical person is quite ready to rely on the conclusions of specialists provided the specialists are reasonably agreed among themselves. But with methods as tentative and dependent on personal peculiarities as are the ordinary methods of statistics such an agreement is impossible.

An increased appreciation of statistical work is bound to react favorably on social science in general. It is possible that economics should become more professionalized than at present. Most individuals of average intelligence would assent to the statement that the trained economist is better able to decide complicated economic questions than are they themselves, but if it came to a matter of personal concern it is doubtful whether the opinion of the specialist in economics would be held in such respect as would that of the physician or lawyer. While there is no particular reason for thinking that formal statistical theory can or should become popular in the generally accepted sense of the term so that anyone could make use of it, yet by giving to statistics, and hence to much of economics, uniformity of method and quantitative definiteness, making possible more elaborate and thoroughgoing investigations, the science would become more professionalized with a consequent increased respect for economics on the part of the public.

However, economics can not hope to escape the experimentation of those who are fascinated by the possibilities of the newer developments in statistical methods but who do not adequately realize the inherent limitations of their data or who do not have sufficient acquaintance with the working

principles of the methods to use them discriminately. To do trustworthy and effective work in statistical economics, the economist must be a statistician, and especially must understand the material from which the data are taken and must know the degree of confidence that the data warrant. To determine the accuracy of the data and to so analyze the numerical facts as to obtain the maximum amount of information from them requires an extensive training in somewhat complicated arithmetic and theory.

But there are few economists with the mathematical equipment necessary for statistical purposes and still fewer mathematicians with an appreciation of the problems of the economist. The physicists have adjusted themselves to a similar situation so that most physicists know considerable mathematics and usually the mathematical student has turned to physical science for a minor study. While this arrangement has worked well for the science in question persons so trained are not particularly qualified to take up statistical investigations. The material of the social sciences is so radically different from that of the physical sciences that it is extremely hard for the physicist, for instance, to adjust his habits of thinking to the new standards. It is very easy for five-place standards of accuracy to be in this way carried over into a field where the figures may often have a margin of error of several per cent.

If students of mathematics are encouraged to take up economics and the more statistical parts of social sciences in general as secondary subjects, great improvements and simplifications in statistical methods will be possible. Only in this way can the economist obtain the aid which experience in other sciences shows to be necessary.

On the other hand, the student of economics must be better trained in mathematics; not so much in the material which makes up the greater part of the courses in mathematics as planned for engineering students as in courses having the needs of the social sciences more in view. Such a course should include detailed practice in algebraic manipulation and in certain especially useful topics of analytic geometry and should lay emphasis on the subject of probability. It is no doubt ad-

visable to have a separate course for the more technical topics of statistical methods such as the smoothing of data, curve fitting, measures of accuracy, correlation, etc. With these two courses students not desiring to specialize in statistics can obtain a fairly comprehensive knowledge of statistical methods by taking the technical course only, while the student expecting to make considerable use of statistics would of course need the more extensive mathematical training.

The relative extent of these two courses should probably vary to accord with local conditions and requirements. It seems quite certain, however, that the practice of devoting a few lectures to the more technical phases of statistical methods in connection with courses in economic statistics can not be productive of results of great value, because such courses are ordinarily given by persons primarily interested in some phases of economics and consequently not likely to have great interest in so characteristically formal a study as statistical methods or mathematics; and because the subject is too extensive and complicated for so brief a presentation. The slight acquaintance gained in this way may indeed be a positive detriment if it does not impress the student with the extent and difficulty of the theory and with the necessity for extreme care and caution in its application. It is easy to lose sight of the fact that a discriminating statistical judgment can be attained only by long training and practice.

It would seem therefore that the most desirable arrangement is for the course in statistical methods to be given by an instructor who is especially interested in methods and formal theories and who has had the benefits of an appropriate mathematical training, and for this course to be followed by the courses in economic statistics and the other courses in social science which make use of statistics and in which formal methods can be employed to advantage.

INFANT MORTALITY AND THE SIZE OF THE FAMILY.

By Henry H. Hibbs, Jr., *Sometime Fellow in Research, Boston School for Social Workers.*

The influence of the birth rate on the rate of infant mortality has been frequently pointed out. Newsholme in his recent report to the English Local Government Board notes "the connection often observed between a high birth rate and a high rate of infant mortality."* Phelps, also, in his study of Infant Mortality and Its Relation to Women's Employment, states that in Massachusetts cities a "more direct relationship exists between infant mortality and the birth rate . . . than infant mortality and the employment of women," although in neither case, as his figures bring out, is the relationship invariable or even close.† The Director of the Statistical Service of France, on the other hand, has shown from an investigation made in 1907 by the Superior Council of Statistics that whatever relationship there may be between the birth rate and the infant mortality rate in cities or countries there is a very close relationship between the birth rate in families—or, what is practically the same, a close relationship between the size of the family and the rate of child mortality. It is not possible from the figures given in his study to separate the statistics for infants under one year of age, but by considering only the period from 1901–1907 it will be possible to secure a group with a maximum age at death of six years. This is done in the following table, which shows the mortality rate for infants whose fathers were employed in the public service of France according to their order of birth, or, in other words, according to the number of previous births in the family:

*Great Britain, Local Government Board, Supplement to the Thirty-ninth Annual Report, p. 49.

†Phelps, Edward B., "Infant Mortality and Its Relation to Women's Employment—A Study of Massachusetts Statistics." In Volume XIII, Part 1, of the Bureau (Now Department) of Labor's Report on Condition of Women and Child Wage Earners in the United States, p. 38.

TABLE I.

MORTALITY RATE PER 1,000 BIRTHS AMONG CHILDREN WHOSE FATHERS WERE EMPLOYED IN THE PUBLIC SERVICE OF FRANCE CLASSIFIED ACCORDING TO ORDER OF BIRTH, 1901–1907. (a)

Order of Birth.	Number of Births.	Infant Mortality Rate.
First born	25,102	113.7
Second born	21,384	121.5
Third born	14,675	139.4
Fourth born	9,750	148.5
Fifth born	6,430	165.2
Sixth born	4,251	173.2
Seventh born	2,783	186.5
Eighth born	1,842	204.5
Ninth born	1,215	187.7
Tenth born	826	236.2
Eleventh born	455	248.4
Twelfth born and over	687	276.6
Total	89,400	138.3

(a) Compiled from Lucien March's "Some Researches Concerning the Factors of Mortality." Journal of the Royal Statistical Society, Vol. LXXV, Part 5, p. 519. (Cf. Appendix.)

This table shows a strikingly close relationship between child mortality and the order of birth, the rate having increased from 113.7 per 1,000 births among the first born children to 276.6 among those who were twelfth born or over.* As has just been stated the relationship shown in this table is between the order of birth and the rate of mortality for children under six years of age. The New York Free Outdoor Maternity Clinic has recently published data collected during the first nine years of its work which show the relationship between infant mortality and the number of children to which the mother has previously given birth—a classification for all practical purposes identical with that in Table I, based on the order of birth.

*The only exception to the regular variation of the mortality rate with the order of birth was in the ninth group but this is not a serious exception, as it may be due to chance.

Dr. Alice Hamilton of Hull House, Chicago, in a recent article, "Excessive Child-bearing as a Factor in Infant Mortality" (Proceedings of the Conference on the Prevention of Infant Mortality, New Haven, 1909, pp. 74–80), shows a similar relationship between the order of birth, or size of the family, and the mortality rate for children under three years of age. Thus, among 1,600 infants born to mothers classified according to the number of children in their family the mortality rate per 1,000 births was as follows:

4 children or less	118
6 children or more	267
7 children or more	280
8 children or more	291
9 children or more	303

Among the Berlin working class Hamburger's investigation has also shown how serious a cause of infant mortality large families may be. (Kindersahl und Kindersterblichkeit. Die Neue Generation, August, 1909). Quoted in Havelock Ellis' "The Task of Social Hygiene," pp. 150–1. Space does not permit the quoting of his figures in full.

TABLE II.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS BORN TO MOTHERS COMING UNDER THE OBSERVATION OF THE NEW YORK FREE OUT-DOOR MATERNITY CLINIC, CLASSIFIED ACCORDING TO THE NUMBER OF PREVIOUS CHILDREN BORN TO MOTHER. (a)

Number of Previous Children Born to Mother.	Number of Births.	Infant Mortality Rate.
Less than 4	1,182	77
4 to 8	1,064	127
8 and over	294	170
0	97	10
1	288	66
2	369	81
3	428	96
4	355	127
5	354	189
6	203	163
7	152	105
8	135	207
9	90	166
10 and over	69	275
Total	2,540	124

(a) Compiled from the First Annual Report of the Free Out-door Maternity Clinic, Covering the First Nine Years of the Clinic's Existence, New York, 1910: Chapter 2, Part 2, Report of the Pediatric Department with a Study of Early Infant Mortality, by Herman Schwarz, M.D., pp. 42–3.

Table II shows a very close relationship between the number of children to which the mother has previously given birth and the rate of infant mortality during the year under consideration. Thus, the mortality rate rose from 77 deaths per 1,000 births for infants born to mothers who had previously given birth to less than four children to 170 for the infants whose mothers had given birth to eight or more.*

In the investigation by the Children's Bureau of infant mortality in Johnstown, Pa., the data gathered bearing on the relationship between fertility and the size of the family and infant mortality were classified according to the order of birth; but, as has already been shown, the terms "order of birth" and "number of the mother's previous pregnancies," though not absolutely identical, may be considered as practically so for our purpose.

*The exceptions to the otherwise continuous relationship of these mortality rates with the number of children to which the mother had previously given birth which appear when, as in the lower part of the table, each group is considered separately, will be discussed in connection with a later table showing similar data gathered in the Boston investigation.

TABLE III.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS INCLUDED IN THE JOHNSTOWN INVESTIGATION CLASSIFIED ACCORDING TO THE ORDER OF THEIR BIRTH.(a)

Order of Birth.	Number of Births.	Infant Mortality Rate.
First and second born	622	138.3
Third and fourth born	400	143.2
Fifth and sixth born	241	177.0
Seventh and eighth born	137	181.5
Ninth and later born	91	201.1
Total	1,491	149.9

(a) U. S. Children's Bureau: Infant Mortality—Results of a Field Study in Johnstown, Pa., Based on a Calendar Year, by Emma Duke. Washington, 1915, p. 51. Hereafter this report will be referred to by the briefer title—Infant Mortality: Johnstown, Pa.

Thus, in Johnstown a relationship appears to exist between fertility and the size of the family and the rate of infant mortality similar to that shown in previous tables for other investigations:*

It is obvious that in this relationship between infant mortality and the order of birth, or the number of previous children to which the mother has given birth, there are two distinct factors present—that of the size of the family in which the child lives after birth and that of fertility in its narrowest sense, including primarily the physical influence of childbearing upon the mother and upon the chances of survival of subsequent infants to which she gives birth. Better expressed, this relationship is brought about by the influence of both prenatal and postnatal conditions on infant mortality. With this in view an attempt was made in an investigation made in 1910 and 1911, by the Research Department of the Boston School for Social Workers, to take account of both of these factors and as far as possible to measure the influence of each.†

*For other figures showing the relationship between infant mortality and the order of birth in the family see—R. J. Ewart, "The Aristocracy of Infancy and the Conditions of Birth," Eugenics Review, Vol. III, p. 166.

†The data collected in this investigation have not been before published. A brief description of the investigation would, therefore, be desirable if space permitted. Visits were made to the homes of 2,063 infants (stillborn infants not included) who were born in 1910 in Wards 6, 8, 13, and 17 of the city of Boston. The birth and death records were copied from the files of the Registry Department of the city and the visits to the homes made by fellows in the Research Department of the School for Social Workers during the academic years 1910–1911 and 1911–1912. During the second year of the investigation this field work was supervised by the writer under the general direction of Dr. T. W. Glocker, director of the Department of Research. The writer in using these data for publication wishes gratefully to acknowledge the interest and coöperation of the fellows who made the visits to the homes, as well as that of the director of the Department of Research. He is also indebted to Dr. J. R. Brackett, Director of the School for Social Workers, for permission to use the data in this way.

The method used was that of dividing the infant deaths into two groups, those reported as due to the diseases of early infancy and congenital malformation and those reported as due to all other causes—the former group being largely dominated by prenatal and the latter by postnatal influences—and showing the relation of the number of the mother's previous pregnancies to the infant mortality rate for each group. These figures are given in the following table, which shows the infant mortality rate per 1,000 births from all causes, from the diseases of early infancy and congenital malformation, and from all other causes for infants classified according to the number of their mother's previous pregnancies:*

TABLE IV.

MORTALITY RATE PER 1,000 BIRTHS FROM ALL CAUSES, FROM THE DISEASES OF EARLY INFANCY AND CONGENITAL MALFORMATION COMBINED, AND FROM ALL OTHER CAUSES FOR INFANTS BORN IN 1910 AND VISITED IN THE HOUSE-TO-HOUSE INVESTIGATION IN BOSTON, CLASSIFIED ACCORDING TO THE NUMBER OF THEIR MOTHER'S PREVIOUS PREGNANCIES.

Number of the Mother's Previous Pregnancies.	Number of Births.	Infant Mortality Rate per 1,000 Births from—		
		All Causes.	Diseases of Early Infancy and Congenital Malformations.	All Other Causes.
Less than 5	1,533	120.0	29.4	90.7
6 to 9	475	134.7	33.7	101.1
10 and over	53	226.4	75.5	228.6
0	371	91.6	24.3	67.4
1	390	100.0	25.6	74.4
2	309	139.2	35.6	103.6
3	265	150.9	41.5	109.4
4	198	141.4	20.2	121.2
5	177	175.1	45.2	129.9
6	118	110.1	16.9	93.2
7	84	107.1	11.9	95.2
8 and 9	96	114.6	52.1	62.5
10 and over	53	226.4	75.5	228.6
Total (a)	2,061	126.2	31.5	94.6

(a) Information was not obtained in two instances.

Table IV shows that the infant mortality rate varies in direct ratio with the number of the mother's previous pregnancies. Thus, among the infants born to the mothers with less than five previous pregnancies, 120 died in every 1,000

*This classification of the mothers differs primarily from that used in the preceding table quoted from the report of the New York Free Out-door Maternity Clinic in that it is based on the number of the mother's previous pregnancies including stillbirths instead of upon the number of living births excluding stillbirths and, secondarily, in that, as previous pregnancies are dealt with, the one resulting in the birth of the infant under consideration is not counted. It was adopted largely because of the difficulty of distinguishing deaths soon after birth from stillbirths.

births, in comparison with 135 among those whose mothers had had from five to ten previous pregnancies, and 226 among those who had had ten or more.* The rate of mortality from the diseases of early infancy and congenital malformation combined and from all other causes varied in the same manner, thus showing that the influence of the number of the mother's previous pregnancies on infant mortality is both prenatal and postnatal.† There are, then, two distinct factors to consider in accounting for this relationship, first, the size of the family, and second, fertility and the effect of childbearing on the health and strength of the mother and her ability to bear strong and healthy children.

*Closer examination of the lower part of the table where each pregnancy group is considered separately shows that the relationship is not entirely continuous. Thus, although the rate increases in almost continuous succession with the number of the mother's previous pregnancies up to the sixth group, it then begins to decrease and continues to do so until the group of mothers having eight and nine previous pregnancies is reached when it begins to rise again, until in the last group the highest rate of all appears. (The rate for the last group when subdivided was 171 for the infants born to those mothers having 10 or 11 previous pregnancies and 333.3 for those having 12 or more.) Practically the same condition is also seen to exist when the previous table compiled from the figures of the New York Free Out-door Maternity Clinic is examined in a similar manner.

Yet, these exceptions do not disprove, as might appear at first sight, the tendency shown when the pregnancy groups were combined. The drop in the mortality rate for the infants born to the mothers who had already had six or seven previous pregnancies is probably due to the fact that a large number of previous pregnancies not only decreases the chances of life of the infants born but, in the case of the weaker mothers, also tends to make childbearing impossible or else so perilous that it is voluntarily refrained from. It is, therefore, to be expected that the proportion of infant deaths to births will begin to decrease after the fourth and fifth pregnancy group when the weaker mothers begin to drop out of the ranks of the childbearing, thus leaving in these groups a larger proportion of strong and healthy mothers whose children will be relatively better fitted to survive.

That the low mortality rate for infants in the sixth and seventh group is due to the inclusion of a larger proportion of strong and healthy mothers in them is shown by an examination of the last two columns of the table where it will be seen that the drop in the rate from the diseases of early infancy and congenital malformations—diseases largely due to the condition of the mother during and before pregnancy—is greater than that from all other causes of death, these being largely the result of conditions arising after birth and not so directly connected with the intra-uterine period of the child's development. But even though from the standpoint of childbearing the physical condition of the mothers in the sixth and seventh groups may be so good that it renders their children relatively immune from the effects of continuous childbearing, in time, if they continue, their children will also be affected, as is shown by the renewed rise in the rate for the groups following the seventh.

These exceptions, therefore, cannot be regarded as vitiating the tendencies shown when the pregnancy groups are combined or as materially weakening the conclusion that the rate of infant mortality varies strikingly with the number of the mother's previous pregnancies and the number of children to which she has previously given birth.

†This follows from the fact—a fact that space does not permit us to submit detailed proof of—that the deaths of infants during the first week and month of life and to a lesser extent during the first three months are largely the result of conditions which affected the child's organism before birth and while it was developing in the mother's womb, or in other words largely the result of prenatal conditions, while the deaths of the later months of infancy are largely the result of conditions which affected the child after its birth, or in other words to the influence of postnatal conditions.

In accounting for this relationship between the size of the family and infant mortality several considerations should be borne in mind. It is to be expected, for instance, that congestion both as shown by the average number of persons per room and the number of persons sleeping in the bedroom with the infant will be greater among large than small families, and this was found to be true in the Boston inquiry.* Poverty, too, is generally agreed to be worse, other things being equal, where the number of small children in the family is large.† Moreover, those parents who bring into the world larger families than their neighbors deem themselves able to rear properly are frequently improvident, with a low standard of life, and in addition, are often characterized by a lack of intelligence or of sufficient knowledge of the simpler laws of hygiene. This is, of course, not true of the parents of all large families but of a sufficient number of them to raise the mortality rate for the class. In the Boston investigation it was found that of 341 mothers of whose character and intelligence the investigators felt competent to express an opinion,

*PER CENT. OF INFANTS VISITED IN THE BOSTON INVESTIGATION, CLASSIFIED ACCORDING TO THE NUMBER OF THEIR MOTHERS' PREGNANCIES WHO LIVED IN HOUSEHOLDS WHERE THE AVERAGE NUMBER OF PERSONS PER ROOM WAS LESS THAN TWO, TWO, OR THREE OR MORE.

Number Mother's Pregnancies.	Less than Two.	Two.	Three or More.	Total.	
				Per Cent.	Number.
1	84.6	14.0	1.4	100.0	349
2, 3 or 4	59.5	35.1	5.4	100.0	908
5 or 6	34.2	44.9	20.9	100.0	350
7 or 8	18.7	61.0	20.3	100.0	192
9 or more	17.7	61.7	20.6	100.0	141
Total	52.3	37.6	10.1	100.0	1,940

†Bertillon in the following figures has shown this relationship of poverty to the size of the family in Paris (Nombre D'Enfants par Familles, Journ, de la Soc. de Statisque de Paris, April, 1901, p. 134. Quoted in Bailey's "Modern Social Conditions," p. 111), in the following table showing the number of children per 100 families in Paris, classified according to the economic resources of their parents (1896):

Very poor	156
Poor	144
Comfortable	131
Very comfortable	129
Rich	129
Very rich	127
Entire city	140

a somewhat larger proportion of the mothers of large families were rated as unsatisfactory in these respects than of those with small families.* The mothers of the larger families also ranked lowest when graded according to their knowledge, or rather their observance, of the laws of hygiene, this being especially evident when they were graded according to their standards of cleanliness and of ventilation.†

But all this leaves unanswered the question whether, other things being equal, the number of children in the family into which the infant is born has any direct postnatal influence upon the mortality rate. Doctor Newsholme, an eminent English authority, feels that it does not. He says, though he gives no data to sustain his opinion, that "large families evidently do not necessarily imply a tendency to high infant mortality. The connection often observed between a high birth rate and a high rate of infant mortality probably is due in great part to the fact that large families are common among the poorest classes, and these classes are specially exposed to the degrading influences producing excessive infant mortality."‡ This view, however, seems very onesided. While it is undoubtedly true, as has already been shown, that "the de-

*These figures were as follows:

Of 341 mothers of whom an opinion was given 81 were unfavorable; classifying these according to the number of the mother's pregnancies (including the one resulting in the birth of the infant under consideration) they were found to include:

8 per cent. of those who had had 1 pregnancy,

29 per cent. of those who had had 2, 3, or 4 pregnancies,

30 per cent. of those who had had 5 or more pregnancies.

†Thus, 781 out of 1,817 mothers from whom information was obtained said that they did not ventilate their bedrooms at all at night.

These included:

40 per cent. of those who had had 1 pregnancy,

44 per cent. of those who had had 2, 3, or 4 pregnancies,

46 per cent. of those who had had 5, 6, 7, or 8 pregnancies, and

32 per cent. of those who had had 9 or more pregnancies.

Thus, with one exception the per cent. of mothers who said that they did not ventilate their bedrooms at night increased with the number of the mother's pregnancies. This exception, which occurs with the mothers who had 9 or more pregnancies, may be due to chance, as the group included only forty cases.

Dr. Herman Schwarz in the First Annual Report of the Free Out-door Maternity Clinic (New York, 1910), p. 41, gives similar figures verifying the statement that the mothers of the larger families rank lower in general intelligence and in knowledge of hygiene than those of smaller families.

Thus, out of 679 mothers, 67 were graded as unsatisfactory in intelligence and 612 as satisfactory, the average number of children born per family being 3.8 among the former and 3.1 among the latter.

Of 670 mothers 491 were graded as having an unsatisfactory and 179 as having a satisfactory knowledge of infant hygiene, the average number of living births per family being 3.9 among the former and 3.5 among the latter.

‡Great Britain, Local Government Board, Supplement to the Thirty-ninth Annual Report, p. 49.

grading influences producing excessive infant mortality" also tend to produce excessively large families—or else both the degrading conditions and the excessively large family are produced by the same deeper-lying causes—it is also just as true that an excessive number of children in the family in itself brings about conditions in the home that lower the infant's chances of survival. The term "large family" is, of course, relative. In some cases, where the parents have sufficient resources, interest, and leisure from other duties, what might otherwise be regarded as an excessively large family would under such circumstances be regarded only as normally large. On the other hand, it is difficult to understand how, in cases where the parents have not the resources, the interest, or the ability to provide for more than three children properly, the chances of survival of subsequent infants born into the family will not be lessened, other things being equal, by the birth of more than this number of children.

It is not difficult to understand how the popular misconception that the death rate in large families is low has arisen. The large families we meet so impress us with the number of children who are living that we forget the number who have died while, again, we never notice the small families that would have been large if so many of the children had not died during infancy and childhood. The writer has been unable to find any evidence whatever to support this popular belief that large families have low infant mortality rates, while there is abundance of evidence to show that the rate of infant mortality increases with the size of the family, and no small amount of evidence to show that the mortality rate for children and even adults is greater in large families than in small.*

The Influence of the Length of the Interval Between the Mother's Pregnancies.—As has already been intimated, the influence—both prenatal and postnatal—of fertility and the size of the family on infant mortality is partly determined by the length of the interval between the mother's pregnancies or deliveries.

*See especially the article by March in the Journal of the Royal Statistical Society, Vol. LXXV, pp. 519 ff., previously quoted, and Dr. R. J. Ewart's two articles in the Eugenics Review on "The Aristocracy of Infancy and the Conditions of Birth," Vol. III, pp. 142–70, and "The Influence of Parental Age on Offspring," Vol. III, pp. 201–232. In the latter of these articles Doctor Ewart shows how the mean height of children is also affected adversely by the order of birth (p. 213).

Where this interval is large the influence of large families is less but where it is small it is much greater. The relation between the average interval between the pregnancies of the mothers visited in the Boston investigation and the rate of infant mortality is shown in the following table:

TABLE V.

MORTALITY RATE PER 1,000 BIRTHS FOR INFANTS BORN TO MOTHERS VISITED IN THE HOUSE-TO-HOUSE INVESTIGATION IN BOSTON, CLASSIFIED ACCORDING TO THE AVERAGE INTERVAL BETWEEN PREGNANCIES.

Average Interval between Mother's Pregnancies.	Number of Births.	Infant Mortality Rate.
1 year or less	159	138.4
1½ years	197	147.2
2 years	641	127.9
3 years	458	128.8
4 years	113	106.2
5 years and over	67	185.0
Total	1,635 (a)	132.1

(a) Information was not obtained in 57 instances. The 371 infants who were born during their mothers' first pregnancies are not included in this table.

Table V may at first sight seem to show no relationship between the average interval between the mother's pregnancies and the rate of infant mortality. Thus, although the rate decreases as the length of the interval increases until the period of five years and over is reached (from 143 where the average interval was less than two years to 128, 129 and 106 where it was two, three, and four years respectively) it then increases to 185 deaths per 1,000 births with the group of mothers the average interval between whose pregnancies was five years and over. Moreover, although the mortality rate for the first two groups combined (one year and less and one and one half years) is greater than that for the next three the rate for the first group proves to be higher than that for the second when they are separated (138 and 147 respectively). Yet, closer examination of the results shows that these apparent exceptions are not of sufficient importance to influence the conclusion.

In the former case, the rise in the mortality rate with the group where the interval between pregnancies was five years or over can be accounted for in two ways; first, on the supposition that the number of cases included in the group is too

small (67) to allow any weight to be given it in drawing conclusions, or, second, on the supposition that such an exceptionally large interval between pregnancies as five years or more is, among families of the class for the most part visited in this investigation, generally the result, not of choice but of weakness or physical incapacity—a condition which would be likely to effect the strength and resistance of such children as might be born and thereby to raise the mortality rate for the class.

In the latter case, the fact that the rate for the group of infants born to mothers with an interval between pregnancies of one year or under is less than that for those where the interval was one and one half years does not disprove the existence of a relationship between the infant mortality rate and the length of the average interval between the mother's pregnancies because the rate for the first group where the average interval was less than one year would have been much higher if it were not composed so exclusively of mothers who had had few previous pregnancies and whose families were, therefore, small—a class which, as has already been shown, tends to have a very low infant death rate. In fact 70 per cent. of the mothers in this group had had only one previous pregnancy.

To fully appreciate the influence of this small interval between pregnancies the mothers in the group must be further classified according to the number of their previous pregnancies. When this is done it will be seen that the mortality rate for the infants born to mothers in the group who had had 1, 2, or 3 previous pregnancies was 129; for those who had had 4, 5, or 6 it was 333; while for those who had had over 6 previous pregnancies it reached the enormous proportion of 500 deaths per 1,000 births. A careful examination of the table, therefore, indicates, when account is taken of the number of the previous pregnancies and the size of the families of the mothers included in each group, that there is a striking relationship between the rate of infant mortality and the average interval between the mother's pregnancies.

Doctor Ewart in a recent article in the *Eugenics Review* emphasized this need for the "adequate spacing of births" by showing that the physical development of the children who

survive is retarded by a short interval between births. Thus, as he shows in the following table, the average height and weight of over 800 children at the end of the sixth year of age was greater where the interval between births was large than where it was small:

TABLE VI.

RELATIONSHIP BETWEEN THE LENGTH OF THE INTERVAL BETWEEN BIRTHS AND THE MEAN HEIGHT AND WEIGHT AT THE END OF THE SIXTH YEAR OF AGE AMONG 866 CHILDREN OF MIDDLESBOROUGH, ENGLAND; 1911. (a)

Interval Between Births.	Mean Height in Inches.	Mean Weight in Pounds.
Less than 2 years	38.6	37.2
2 and under 2½ years	39.9	38.8
2½ to 3 years	40.3	39.1
3 years and over	41.7	39.4

(a) R. J. Ewart, M.D., "The Influence of Parental Age on Offspring," Eugenics Review, Vol. III, p. 211.

In commenting on this table Doctor Ewart says: "The female is used to the greatest extent that her fertility will allow; births at intervals of eleven months being quite common. . . . The birth interval is so short that the mother is unable to bring her whole vitality to bear. Thus one child, as it were, spoils the next." He then asks this very pertinent question: "Which is the most desirable, three children of a mean height of 39.5 inches or two of 41.0 inches, with all the other attributes of mankind altered in the same proportion? . . . As regards the individual there is no hesitancy as to the answer; but from the point of view of economic production it is quite possible that three inefficients may be better and do more work than the two efficients. Racial supremacy, however, is not a question of numbers, and concerns individual fitness only."

It must not be forgotten, moreover, that the mothers themselves do not escape without injury from the strain put upon them by too frequent childbearing; but this lowering of the vitality and strength of the mother as a result of an insufficiency of time between the two pregnancies for complete recovery from the strain of the first creates a condition which will be likely, other things being equal, to harmfully affect both the prenatal and postnatal development of subsequent

children. In fact, both the mother and the children suffer when the length of the interval between births is too small. It is manifestly impossible for most mothers to properly nourish themselves, a new born baby, and a child within the uterus at the same time.

This point is especially important, for artificial feeding is more often resorted to by these mothers who are attempting to rear two babies at once—one within the womb and the other just born. Among the mothers visited in the Boston enquiry, for instance, 25 per cent. said that they had resorted to the use of bottle feeding because the quantity or the quality of their breast milk was reduced by a subsequent pregnancy. Among the Italian mothers this reason was given in over half the cases—a truly astounding proportion. Thus, when it is remembered that bottle feeding decreases the chances of survival of the baby from three to five times (as all authorities agree),* it can readily be understood how the coming of one child spoils the chances of survival of the previous one.

It is thus apparent that the influence of fertility and the size of the family, especially when combined with the influence of the length of the interval between pregnancies, constitutes an important factor in infant mortality. As Doctor Ewart says: "The wastage of life, and production of immature progeny with its consequent misery and suffering to the mother, can, to a much larger extent than is generally believed, be traced directly to the unfortunate fact that the fertility of women between their twenty-fifth and thirty-fifth years exceeds their power to reproduce healthy offspring." † However dangerous "race suicide" and the declining birth rate may be there can be little doubt that excessively large families is no remedy, and however desirable a high rate of births may be it is mere waste to bring children into the world faster than the laws of nature decree to be desirable.

*See, for instance, the report of the investigation by the Children's Bureau of Infant Mortality; Johnstown, Pa., pp. 38–4, Davis' "Statistical Comparison of the Mortality of Breast-fed and Bottle-fed Babies" in the Am. Journ. of Diseases of Children, March, 1913, pp. 234–47, and the U. S. Bureau of Labor's Investigation of Infant Mortality in Fall River, Mass.

†Prev. cit., p. 215.

MEASURE OF RURAL MIGRATION AND OTHER FACTORS OF URBAN INCREASE IN THE UNITED STATES.

By John M. Gillette and George R. Davies.

Among those who discuss urban and rural matters the usual assumption relative to urban increase of population is that city growth is almost wholly due to the migration of people from the country and that the so-called rural depopulation is due to the same cause. One of the writers has made several attempts to estimate the force of the factors of urban increase, although those estimates must now be regarded as inconclusive and incorrect.* Practically no one else seems to have been interested in the publication of estimates of city gains. But recently Professor F. Stuart Chapin has published an article entitled "Immigration as a Source of Urban Increase."† It is believed that the present article contains fairly complete and accurate estimates touching several points related to urban increase.

In revising his Constructive Rural Sociology, one of the present writers again took up the work of estimating the force of the various factors contributing to urban population increase. It was his good fortune to hit upon a method of treating the subject which takes the calculations out of the realm of guess-work. The present article embodies the chief features of the method and gives the various results, some of the most important of which are by-products of the end aimed at. An application has been made of the method to each of the nine geographical divisions of the nation and a rate of natural increase of population has been attained, in spite of the fact that we are lacking birth registration and that death registra-

*See articles by John M. Gillette, "City Trend of City Population and Leadership," Quarterly Journal, University of North Dakota, October, 1910; "The Drift to the City in Relation to the Rural Problem," American Journal Sociology, Vol. 16, p. 645; "Constructive Rural Sociology, Chapter, Rural and Urban Increase."

†Quarterly Publications, American Statistical Association, September, 1914.

tion is partial for the nation. It is the aim to publish this part of the work at some later date.

After the writer alluded to above had blocked out the method employed in the rough he was joined in the work by his colleague, Dr. George R. Davies, who contributed many suggestions toward purifying the method and giving it greater accuracy. That part of this paper which deals with the application of the method to the various classes of cities of the nation is entirely his work.

This paper claims to attain four results relative to the decade, 1900–1910, none of which, save perhaps the first one enumerated, have previously been worked out. 1. The establishment of a rate of natural increase for the national population. 2. The establishment of the birth rate, and the rate of natural increase for both the rural and urban groups of the nation. 3. The establishment of the force of each of the factors contributing to urban increase of population. 4. The establishment of the same for the various classes of cities.

Natural Increase in the United States.—Before we are able to determine the force of the various factors which produce the increase in urban population it is necessary to discover the rate of natural increase for the nation as a whole. The rate of increase of the total population between 1900 and 1910 was 21 per cent. But it is obvious that the natural increase rate must be much less than this since the nation has received millions of persons from abroad and sent out hundreds of thousands of emigrants during that interval. Hence to determine the natural increase rate it is necessary to consider the factors of immigration and emigration.

There are two methods of discovering the force of immigration in determining the rate of natural increase for the United States. One method is to use the net immigration worked out by the last Census (Thirteenth Census, *Abstract*, p. 191). The other is to use the foreign born population living in 1900 and 1910 as a basis to discover the amount of the new decennial immigration. The latter method is employed here because it is the one used in the subsequent operations of obtaining the natural increase for the various geographical divisions and the force of the factors of urban increase. The

results obtained by the two methods differ so slightly as to be inconsequential.

The foreign born population of the nation in 1900 was 10,341,-276. Reducing this amount 20 per cent. to allow for deaths during the decade (Figured from statement of Census, 1910, Vol. I, p. 1017) the number living in 1910 is 8,273,000. The number of foreign born according to the Census of 1910 was 13,515,886. Subtracting those of 1900 who were living in 1910 from the number given in 1910, the difference, 5,242,286, represents the new immigrants. To get the full force of immigration on increasing the national population during the decade this amount must be increased by 17.4 per cent., a percentage now to be explained.

To the 5,242,000 new immigrants should be added their children which were born in the United States. The birth rate for the immigrant group was estimated at 38.96 per thousand annually. This conclusion was reached by taking the average birth rate of all the countries from which the larger number of the immigrants come. This was found to be 31.5. This rate should be increased 68.5 per cent. because of the fact that immigrants are predominantly adults.* A decrease in the resulting rate of 77.3 per cent. must be made to allow for the fact that a large number of the immigrants leave their wives in the home country.† Allowing next for the death rate among the children of the immigrants, the net result of 17.4 per cent. increase is obtained, amounting to 912,000. This gives the total force of new immigration during the decade of 6,154,000.

Emigration must also be considered. It is strange that there are nc reliable statistics for the total amount of emigration of the citizens of the United States to foreign countries. Yet the amount must be considerable, as it is well known that a large number of farmers and laborers have gone to Western Canada, and there has been in addition some exodus to the Philippines, Mexico, Cuba and Porto Rico, South America, and other regions. Fortunately, however, a failure to esti-

*Comparison of probability curve, based on figures in Statistical Abstract, U. S., 1913, p. 86, with the normal age distribution of population.

†Jenks and Lauck, "The Immigration Problem" (p. 466).

mate closely this item is not at all serious since it has little or no effect on the principal result sought—namely, the migration from rural to urban districts—except in so far as the emigration is proportionately greater from one district than from the other. The reason for this is that the estimate of the emigration affects the computation of the natural increase, and it will be seen that the two items offset each other when it comes to finding the balance accounted for by migration from country to city. And in so far as this emigration is in excess of the normal ratio from the rural districts it can be stated with some approach to accuracy.

A safe estimate for the total emigration during the decade would be 550,000, of which 192,500 may be assigned to emigration from cities.* Add to this the natural increase of the emigrants for the average of five years that the group would be out of the country—anticipating the rate of 13.7 per cent.—and we have the item of 588,000 as the total loss by emigration from the United States as a whole during the decade under consideration.

Bringing together the results thus far obtained it can be stated that the balance of immigration over emigration accounts for an increase by 1910 as compared to 1900 of 5,566,000 for the country as a whole.

In the light of the preceding deductions, it becomes an easy matter to compute the natural increase of the population of the United States during the decade. The total increase as shown by the Census was 15,977,691. Deducting from this the number accounted for by the excess of immigration over emigration as just stated, there remains a balance of 10,411,000—taking the nearest hundreds.

Comparing this number—which of course must represent the natural increase of the national population—with the population of almost 76,000,000 in 1900, there is found to be an increase of 13.7 per cent. for the decade.

The substantial accuracy of this rate is vouched for by employing another method to arrive at the natural increase of population. This is based on an estimate of the birth rate of the national population and the use of the mortality rate

*Immigration Facts and Figures, 1911, Dept. of Interior, Ottawa, Canada, p. 20.

given by the government mortality reports. The number of children under 5 years in urban communities in 1910 was 4,200,000 in round numbers. This represents 86 per cent. of those born. This rate is obtained by taking the average death rate from a probability curve made from the data contained in recently published life tables (American Life Tables, C. H. Forsyth, Amer. Stat. Association, Sept., 1914, p. 234). The entire number of children born was 4,880,000. Dividing this number by the estimated urban population midway between 1907 and 1908, to get the average age of the children of the five year age group, the birth rate per year of 2.47 is obtained, which converted into a decennial rate becomes 24.7. Treating the rural five year age group and the correlative population in the same manner a rural birth rate of 30.36 for the decade is obtained.

The average mortality rate for urban districts of the registration area is found to be 15.9; that for rural districts, 13.4. Subtracting these rates from the appropriate birth rates we get a natural increase rate for urban districts of 8.8 and a rural rate of 16.96. Employing the method of weighted average we obtain the natural increase rate for the whole nation of 13.68, or practically the previous rate of 13.7.

Relative Force of the Factors Contributing to Urban Increase.—The factors which account for urban increase in the United States are immigration and emigration, incorporation, natural increase, and migration from rural districts. A treatment of each of these factors will indicate their relative force in urban gains.

1. It is a simple matter to demonstrate that alien immigrants are settling dominantly in a few states and in the cities. Thus in 1909, 6 states, Massachusetts, New York, New Jersey, Pennsylvania, Ohio, and Illinois, received 529,688 aliens and lost 152,178, retaining 71.3 per cent. In that year those states contained 71.1 per cent. of all immigrant aliens of the nation. During the period 1908–1913 those states, together with California, Connecticut, and Michigan received 70 per cent. of the net immigration of the country. The 6 states first mentioned also sustained 49.2 per cent. of the national urban increase. The 9 states above mentioned, together

with Wisconsin, Minnesota, Texas, and Washington, accounted for 71.1 per cent. of the urban gain of the nation. By a comparison of urban growth and immigration it is evident that the immigration to the 6 states and the 13 states named above almost equals their urban increase. That to the whole nation is equal to 74.5 per cent. of its urban increment. There is thus reason for thinking that immigration to the United States outside of the above states has less to do with populating cities that it does within those states.

We have not thus far demonstrated in exact statistical terms what portion of the immigrants which go to the different states settle in cities. The facts just presented create a strong presumption that the immigrants largely locate in cities. This presumption becomes all the stronger when we consider the industrial situation. Relative to that of the 6 states considered above, is there any reason to think that any large portion of their immigrant aliens go into agriculture? All of those states have had their available agricultural land occupied for a long time, and while land changes owners to a limited extent the scope of the exchange is too limited to absorb many of the immigrants. Nor is there evidence that immigrants to any considerable extent are purchasers of land in those states. And what is true of the 6 states obtains in Connecticut and is only a little less true of the 7 additional states which constitute the 13.

Therefore, since the states alluded to manifest nearly three fourths of the urban increase of the nation, since they absorb almost as great a proportion of the immigration, since the amount of their immigration equals so much of their urban gain, and since the logic of their industrial conditions is against the absorption of their immigrants by agriculture, the conclusion must be that their immigrants largely settle in their cities and in a large measure cause their growth.

Having established the probability that immigrants predominantly settle in cities it is necessary to bridge the gap and show to what extent they actually do so and what proportion of urban increase they account for. A previous statement exhibited the decennial increase of the population of the nation

which was due to the immigration of the decade, together with its natural increase.

What portion of this immigration which arrived during the decade 1900–1910 goes to the cities may be determined as follows. There were in 1910, 13,515,886 foreign born in the United States, of whom 72.2 per cent., or 9,770,000 were living in urban districts. (Thirteenth Census, Vol. I, pp. 139 and 189). In 1900 the number of foreign born in urban districts, similarly computed, was 6,910,000. In order, however, that precisely the same territory may be compared there should be added to the latter the foreign population of rural territory that becomes urban by 1910. The total population of this territory, was 813,000 in 1900 (Table 37, Vol 1, p. 60, Thirteenth Census). This territory being at the line between urban and rural may be taken as having about the same percentage of foreign population as the United States taken as a whole, or 13.6 per cent. This percentage, 111,000 added to the former total, gives 7,015,000 as the total foreign born population in 1900 living in territory urban at the close of the decade. Of this number 80 per cent. would be living in the United States at the close of the decade, or 5,612,000 (Thirteenth Census, *Abstract*, p. 191). The difference between this number and the number of foreign born enumerated in 1910 would of course represent the net result of the immigration to the cities during the decade. The difference is 4,145,000, or 79 per cent. of the total immigration of the decade. With this may be taken the proportionate share of the offspring of the new immigrants as previously computed, or 721,000, making a total of 4,866,000 of the urban population in 1910 which is accounted for as the result of foreign immigration.

2. The contributive force of natural increase of urban populations in accounting for their gains is quickly estimated, since we were obliged to establish the urban natural increase rate in demonstrating the second method of obtaining the rate of natural increase of the nation. It was found to be 8.8 per cent. Applying this rate to the urban population of 1910 the resulting increase for the decade is found to be 2,715,000. From this amount must be deducted the number of emigrants having their origin in the cities who leave the United States

permanently. It was found that the emigrants together with their natural increase for the decade ending 1910 numbered 588,000. The due portion which came from urban districts amounted to 206,000, leaving 2,509,000 as the contribution the cities make to their own gain by natural increase.

3. It is evident that a certain part of the increase in urban population as given in the census is to be attributed to the fact that towns under 2,500 in 1900, which are then counted as rural territory, may pass the 2,500 mark during the decade and be included in the urban population in 1910. In a similar way a large city may grow and absorb the population of a suburb that in the early part of the decade was rural territory. The amount of population transferred bodily in these ways from one classification to the other has already been stated on the authority of the census as being approximately 813,000. To this must be added the natural increase of the same population, which at the rate of 13.7 per cent. already determined would amount to 111,000, making a total of 924,000 to be accounted for in this way. The foreign immigration to this territory during the decade has already been taken into account by considering the territory urban and including it in the computation for the results of immigration, as given.

4. There remains the computation of the amount of urban growth to be accounted for by migration from rural regions. The simplest way to arrive at this is to deduct from the total urban growth as shown in the census the various items now determined. These items, with the percentage that each is of the total gain, are as follows:

	Amount.	Per Cent. of Urban Increase.
Urban gain, as per census	11,826,000	
Accounted for by immigration	4,866,000	41
Accounted for by natural increase of population	2,509,000	21.6
Accounted for by incorporation of new territory with urban territory	924,000	7.6
Balance, migration from rural to urban districts	3,527,000	29.8

It will be seen that the same method that has been applied to the problem of urban increase might be applied to rural

increase. The result, of course, should be the same total migration to the cities that has just been determined. The computation has been made and the required result obtained, but it is not worth while to take the space for the computation in view of the fact that the one item in common is rural migration to cities and that has proven to be the same.

The question might be raised as to how much of the rural migration appearing above is from the open country, and how much is from the incorporated places under 2,500 classified as rural in the census. There appear to be no data from which this question may be answered with precision, but on the other hand there is no marked objection that can be urged against assuming that the migration from the open country was as least proportionate to its population. In fact it probably was more than proportionate, since, as it will be shown, the migration to the group of smaller cities is clearly marked and incorporated places under 2,500 would present conditions somewhat similar to those in cities in the class next above 2,500. The census shows that 83.5 per cent. of so-called rural population is actually in the open country (Thirteenth Census, Vol. I, p. 64). It is therefore safe to conclude that at least 2,950,000 out of the total 3,527,000 rural migration, represents the movement from the open country to the city.

Urban Increase by Classes of Cities.—It will be of interest to carry the analysis of the increase of urban population one step further and compute it for the various groups of cities as classified by size. The results of this analysis are given in the accompanying table. The methods used are the same as in the preceding study, except as will be explained. The principal difference in method is in handling the amount of population which changes its classification or is incorporated with the growing city during the decade. It would be difficult to compute just what this amount would be for each class of cities, since each class both loses and gains a certain amount during the decade. The computation is therefore based directly upon the population of territory as it was classified in 1910, carrying this classification back to 1900. The classification in this form is given in the census (Thirteenth Census, Vol. I, p. 71). By this method there is, of course, no gain by

change in classification or by incorporation to be considered. The gain by immigration is determined by the same method as before; that is, the foreign population in 1900 is decreased 20 per cent. for deaths and subtracted from the foreign population in 1910. The determination of the foreign population for the several groups of cities in 1900 is, however, somewhat difficult to reach, as the census does not analyze the 1900 population on the basis of the 1910 classification so as to show the foreign born population. The method used was as follows. A graph was drawn representing on the base line the population of the various groups of cities as then classified, in the order of the size of the cities. Vertically above the base line distances were measured to represent the percentage of foreign born white as given for each group of cities (*Ibid*, Vol. I, p. 184). The percentage of foreign born white was found to increase quite regularly with the increase in the size of cities, allowing the drawing of a fairly regular curve. The base line was then subdivided again on the basis of the classification of cities according to their grouping in 1910, and from the curve the percentages of foreign born white were read. These percentages were then applied and the number of foreign born white found for each group of cities. A slight increase (between 1 and 2 per cent.) was made to include the small number of foreign born colored. The offspring of these new immigrants during the decade was determined at the same ratio as previously found for the total new immigration, 17.4 per cent. The emigration was determined by distributing among the various groups in proportion to their total population the emigration from urban districts as previously estimated. The natural increase was also taken as before at 13.7 per cent. for the decade. The balance necessary to make up the total gain for each group of cities was taken, and regarded as the measure of rural migration to the cities. It will be seen, however, that in the case of the group of largest cities the balance is negative, indicating a loss of population to smaller cities or rural regions. This is very likely to be accounted for by the formation of the so-called satellite cities by the removal of large industries to less populous out-lying districts. The totals in the table when compared with the former summary

will be found to give slightly different results, due to the change in classification of the 1900 population.

There is throughout the calculations which have been made in working out the method of treating the various factors considered in this paper a certain degree of error which is due to the limitations of the slide rule. But as the errors are not of the cumulative kind, and as totals may be checked, the total error due to this source is almost negligible.

ANALYSIS OF INCREASE OF URBAN POPULATION, 1900–1910. CITIES CLASSIFIED ACCORDING TO THEIR POPULATION IN 1910.

	Cities having in 1910 a population of:					
	2,500 to 10,000.	10,000 to 25,000.	25,000 to 100,000.	100,000 to 500,000.	500,000 and over.	Totals.
Population, 1910	8,470,000	5,609,000	8,242,000	8,790,000	11,512,000	42,693,000
Population of same territory, 1900	6,195,000	4,153,000	5,977,000	6,354,000	8,931,000	31,610,000
Gain for decade	2,275,000	1,456,000	2,265,000	2,436,000	2,581,000	11,013,000
Gain by foreign immigrants and their offspring	622,000	476,000	865,000	910,000	1,993,000	4,866,000
Per cent. of gain	27.3	32.7	38.2	37.4	77.1	44.2
Loss by foreign immigration including offspring	−40,400	−27,100	−38,900	−41,500	−58,100	−206,000
Per cent. of loss	1.8	1.9	1.7	1.7	2.2	1.9
Gain by natural increase of population	543,000	365,000	527,000	560,000	787,000	2,782,000
Per cent. of gain	23.9	25.1	23.2	23	30.5	25.3
Balance, migration from rural regions, or other cities	1,150,000	642,700	911,900	10,075	−140,900 (a)	357,100
Per cent. of gain	50.6	44.1	40.3	41.3	5.4 (a)	32.4

(a) Loss.

CONTRIBUTIONS TO URBAN GROWTH.

By Earle Clark, *Russell Sage Foundation.*

The rapid growth of the population of American cities is a familiar and widely discussed statistical fact. In recent years the cities have contributed much more than their proportional share to the growth of the country's population. From 1900 to 1910 the population of urban communities increased by 35 per cent. while the population of rural territory increased by but 11 per cent. The increase in numbers in the total population for the decade was 15,977,691, and of this increase 11,013,738, or 69 per cent., was urban increase. *

There are three possible sources of urban growth—alien immigration, natural increase (the excess of births over deaths), and migration from rural to urban communities. What is the contribution made by each of these sources? Is alien immigration, as has been suggested, the preponderant source of city growth? †

It is perhaps natural that such a rôle should be imputed to alien immigration. Of all the factors which have their part in the growth of population, immigration is the only one which in the United States is systematically recorded. The figures roll up into the millions in each decade, while the even greater number of births and deaths is only partially registered. Hence immigration looms larger perhaps in the popular estimation than its importance really deserves.

Information as to the relative share of alien immigration and natural increase, and, in relation to cities, as to the influx from the rural regions may be defective, but that need not deter us from the examination of the relative importance of these three factors in determining the growth of cities. We may indeed tread the ground of estimate rather than of enumeration, but evidence may be gathered and sifted to establish a reasonable probability. It is the purpose of this article to make such an effort.

* Census of 1910, *Abstract*, p. 55.

† Chapin, F. Stuart, Ph.D., "Immigration as a Source of Urban Increase." Quarterly Publications of the American Statistical Association, September, 1914, p. 223.

Gillette, John M., "Drift to the City in Relation to the Rural Problem," American Journal of Sociology, Vol. 16, p. 645.

Most of the statistical data which are available for the purpose are found in the United States Census reports for 1890, 1900, and 1910, and in recent reports of the Census Bureau on Mortality Statistics. This study deals chiefly with the decade 1900–1910, but some facts will be presented for the preceding decade.

From 1900 to 1910 the urban population of the country, that is, the population of the places having, in 1910, 2,500 or more inhabitants, increased from 31,609,645 to 42,623,383—an advance of 11,013,738. * What were the sources of this increment?†

The growth of city populations is the result of the action and interaction of a number of factors, some of which tend to augment and others to reduce the number of inhabitants. The factors which add to population are births, the coming in of people from foreign countries, and, in the case of city populations, the coming in of people from rural territory. The factors which tend to reduce population are deaths, the removal of people to foreign countries, and, in the case of city populations, removals to rural territory. It will be convenient, for the purposes of this discussion, to distinguish between births and deaths, the natural gain or loss, on the one hand, and the movements of population into and out of a given territory on the other hand.

Natural increase or decrease is determined by the difference between the number of births in a given period and the number of deaths. If the population of a territory was 1,000 at the beginning of a decade and, there being no movement of people into or out of the territory, 50 deaths and 100 births occur during the decade, the population at the end of the decade is, clearly, 1,050. The natural increase, figured on the population at the beginning of the decade, is 5 per cent. In a case of this sort, some of the 50 deaths reported would have occurred among the 1,000 persons living in the territory at the beginning of the decade, and some among the 100 children born during the decade, but the effect on population would be the same as

* Census of 1910, Vol. I, p. 62.

† Throughout this study, the exact figures as shown in Census reports, and the exact results of computations have been presented in preference to the round numbers. This procedure has been followed for convenience in checking. It will be understood that all the figures are to be considered as, at best, approximations to the truth. In drawing conclusions from the statistics, ample allowance has been made for the presence of this factor.

though all of the 50 deaths had occurred among persons alive at the beginning of the decade. It seems clear, on the other hand, that, where immigration occurs, deaths of persons who come in after the beginning of the decade and die in the territory before the end of the decade should not be considered in determining natural increase—that such deaths should be taken into account in fixing the gain from alien immigration. This is the procedure that has been followed in preparing the present study.

It can not be too strongly emphasized that the factor of natural increase applies to the whole population at the beginning of the decade, irrespective of its origin.

The number of the people in any region is affected not only by births and deaths, but by the passing of people from territory to territory. There is a movement into American cities from the country districts and a reverse movement from the cities into the country. Any excess of the inward over the outward movement represents an increase of urban population.

Still another factor affecting population is the movement of people from foreign countries into the cities and from the cities into foreign countries. This movement includes two distinct elements. The first element consists of natives of the United States who, in a given decade, remove from American cities to foreign countries or, having been abroad at the beginning of the decade, return to cities during the decade. It is clear that persons of this class going out tend to reduce and that persons coming in tend to augment urban population. Little or no statistical information is available as to the volume of this movement to and from American cities. The incoming and outgoing movements tend to balance each other and there is reason to believe that the balance is of slight relative importance.

The other element in the movement of population between American cities and foreign countries is contributed by persons of foreign birth. Of the foreign born persons residing in American cities at the beginning of a decade, a considerable number remove during the decade to foreign countries. On the other hand, in each decade a number of persons of foreign birth enter the United States from abroad and at the end of the decade are living in urban communities.

It is evident that the foreign born persons coming to the United States in any given decade, who settle in cities and are alive and in cities at the end of the decade, add to urban population, while foreign born persons who, having been in the country and in city populations at the beginning of a decade, depart to foreign countries before the end of the decade reduce urban population. The excess of persons coming in and remaining at the end of the period over persons going out, if there be an excess, represents the increase in urban population due to the immigration of the foreign born.

Alien Immigration.—What part of the urban increase from 1900 to 1910 was due to alien immigration? It is clear that the effect on population of the coming in of aliens is both direct and indirect. The direct effect is the gain due to the arrival of persons born abroad. The indirect effect is the gain due to the births of children of immigrants and of their children's children. All but a very small portion of the native born population of the United States is an indirect effect of immigration which has occurred during the last three centuries.

In undertaking a statistical study of the sources of urban increase it is necessary to keep within the limits set by the character of the evidence. As to persons actually born abroad, the statistical evidence is fairly complete; as to their children, it is much less complete. Children of the third and fourth generation are, for statistical purposes, indistinguishable from the rest of the native born population. In this article only the direct effect of immigration—the increase in population due to the coming in and survival of persons born abroad—will be considered.

The gain in the population of a given territory in a decade through alien immigration is a composite result. The first element is the whole number of foreigners who entered the territory during the decade, less those who left the territory and those who died during the period. This is the addition to the population made by alien immigration. But the increase by such immigration consists of such addition, less a deduction for those foreigners who were in the territory at the outset of the decade who during the period left the territory. The distinction between the addition to population through alien

immigration, and the net increase of the population through such immigration is an important one for the inquiry which is here undertaken.

What we have called the addition to the population through alien immigration, namely, the foreigners who having arrived in a given territory during the decade were found living in it at the end of the period, is the exact equivalent of the number of persons of foreign birth in the territory at the end of the decade who had been in the country 10 years or less. Information as to the number of residents of urban communities who, in 1910, had been in the United States 10 years or less, is supplied by Census reports.

Of the 9,745,697 foreign born persons living in urban communities on April 15, 1910, 3,559,571 are reported as having arrived in this country after January 1, 1901. For 823,124 more the time of immigration is not reported. If it be assumed that the proportion of persons who immigrated after 1900 is the same for this latter group as for all persons the year of whose immigration is known, 39.9 per cent., the total number of foreign born persons surviving in 1910 who came to the United States subsequent to January 1, 1901, was 3,887,997. *

The Census of 1900 was taken as of June 1, and some foreign born persons found in cities in 1910 must have entered the country between June 1, 1900, and January 1, 1901. The number of these survivors is not exactly known, but may be estimated, either by reference to the number of survivors who entered the country from January 1, 1896, to January 1, 1901; or by reference to the number who came in from January 1, 1901, to January 1, 1906. If it be assumed that the number of foreigners living in American cities in 1910 who came to the United States in the 7 months from June 1, 1900, to January 1, 1901, stood to the number of those who came in the 60 months from January 1, 1896, to January 1, 1901, in the relation of 7 to 60, they must have numbered approximately 105,759. † In such a case the total number of foreign born residents

* Census of 1910, Vol. I, pp. 1021–2. Even if it were assumed that all of the 823,124 persons for whom year of immigration was not reported had arrived in this country within 10 years (and it is certain that all of them did not), the number of foreign born persons of less than 10 years' residence would be 4,382,695, a number which is 39.8 per cent. of the total urban increase.

† Census of 1910, Vol. I, pp. 1019–22. The number of persons found in cities in 1910 who arrived in the United States from January 1, 1896, to January 1, 1901, has itself been estimated by assuming that the ratio of urban residents of foreign birth to all residents of foreign birth was the same for persons who came in from 1896 to 1901 as for persons who came in from 1901 to 1906.

found in the cities in 1910 who had entered the country after the 1900 Census would have been 3,993,756. If, on the other hand, the number of foreign born residents of American cities in 1910 who entered the country in the 7 months from June 1, 1900, to January 1, 1901, be calculated in the ratio of 7 to 60 with reference to the foreign residents of 1910 who entered the country in the 60 months succeeding January 1, 1901, their number would be 202,517. In this case the total number of foreign born residents of 1910 who entered the country between the Census of 1900 and the Census of 1910 would have been 4,090,514. Neither of the estimates is more than approximately correct. Both fail to take account of the operation of the death rate which has presumably had a greater effect on the earlier immigrants than on the later, or of the general increase in the amount of annual immigration. Hence, the first assumption will result in an under-estimate and the second in an over-estimate. It is clear in any case that 4,090,514, the largest figure cited, the sum of a known figure and the maximum estimate, represents the maximum contribution to city populations made by alien immigration between the Census of 1900 and that of 1910.

The fact indicated by the foregoing figures is the contribution made by immigration to urban population, while the fact which we are seeking to establish is the contribution made by population to urban increase. As has been seen, contributions to population and contributions to increase are two very different things. Some foreign born persons living in American cities in 1900 left the country before the Census of 1910, and in attempting to determine the net increase due to immigration the number of these persons, if ascertainable, should be deducted from the number of foreign born persons found in cities in 1910 who had come to the United States within 10 years.

As the number of foreign born persons who emigrated from the United States, whether large or small, is to be deducted from the number of immigrants, it is evident that the figure cited above—4,090,514—represents, not only the maximum contribution of immigration to urban population, but the maximum contribution of immigration to urban increase. Is it possible to estimate closely immigration's minimum contribution to urban increase?

In order to ascertain the exact number of foreign born persons found in American cities in 1900, who emigrated from the country before 1910, it would be necessary to determine, not merely the number of persons who left the United States between 1900 and 1910, but the number departing in that period who were in the country in 1900, and were living in urban communities in 1900.

The reports of the United States Commissioner-General of Immigration show the total immigration to the United States for the years 1901–1913,* inclusive, and the number of aliens emigrating from the country for the years 1908–1913, inclusive. The emigrants are classified according to length of residence in the United States. If it be assumed that the ratio of departure to arrivals was the same for the years 1901–1907, inclusive, as for the years 1908–1913, inclusive, and that the distribution of the emigrants according to length of residence was the same for each year from 1901 to 1910, inclusive, as for the six-year period mentioned, then the approximate number of aliens in the United States in 1900 who left before 1910 was 782,423. This estimated number does not include those foreign born persons living in cities in 1900, and leaving the country before 1910, who were citizens of the United States at the time of their departure. It does include, however, aliens leaving the country between 1900 and 1910 who returned to the United States and to city populations again before 1910; and, what is more important, aliens who were living, in 1900, not in cities but in rural communities. It is believed that the inclusions outweigh the exclusions by a wide margin; hence that 782,423 represents the maximum number of foreign born persons found in urban communities in 1900 who left the country prior to 1910; and that, even when allowance is made for the fact that 4,090,514 is a maximum figure for the foreign born in urban communities in 1910 who came in after 1900, this number, less 782,423, that is, 3,308,091, represents the minimum contribution of immigration to urban increase.

As has been seen, the gain in urban population from 1900 to 1910 was 11,013,738. The maximum contribution of immi-

* The years to which the immigration statistics, referred to in this paragraph, relate are fiscal years ending June 30.

gration has been fixed at 4,090,514; the minimum has been estimated as 3,308,091. Hence the gain due to immigration does not exceed 37.1 per cent., and probably does not fall short of 30.0 per cent. of the total urban gain.

The facts regarding the contribution of immigration to urban population in the decade 1900–1910 may be compared, roughly, with facts for the preceding decade. The Census of 1900 does not show year of immigration of foreign born residents for all urban communities, but such information is available for cities which had, in 1900, 25,000 or more inhabitants. There were, in the 161 cities comprising this group, 1,323,234 persons of foreign birth who were reported as having been in the United States less than 10 years, and 380,543 foreign born persons for whom length of residence was not reported.* Assuming that the proportion of persons who had entered the country within 10 years was the same for the group last mentioned as for all persons the year of whose immigration was known, 27.8 per cent., the number of immigrants of less than 10 years' residence was 1,429,025. And as the population of cities having 25,000 or more inhabitants in 1900 increased in the decade 1890–1900 from 14,903,162 to 19,757,618, an increase of 4,854,456 persons,† immigration's contribution to population constituted but 29.4 per cent. of the total gain.

It should be remembered that the facts just given for the decade 1890–1900 relate to immigration's contribution to urban population rather than to urban increase. As available information concerning the volume of emigration is less complete for this decade than for the decade 1900–1910, it seems inadvisable to attempt an estimate of the gain in city population which is traceable to immigration.

Had immigration been the chief cause of urban increase in the 20 years from 1890 to 1910, there would have been, necessarily, an advance from census to census in the proportion of foreign born persons in the urban populations. The number of foreign born persons in urban populations is much less than half the total population, and hence any increase in the number of foreign born as great as or greater than the increase in

* Census of 1900, Vol. I, pp. 958–9.
† Census of 1900, Vol. I, p. lxxiii.

the number of native born would mean a considerable increase in the proportion of foreign born persons in the population.* The proportion of foreign born whites in communities of 2,500 or more inhabitants, classified by size, is shown by the following table for the dates 1890, 1900, and 1910:

FOREIGN BORN WHITES IN URBAN POPULATIONS. (a)

Groups of Communities.	Per Cent. of Foreign Born Whites in		
	1910.	1900.	1890.
All urban communities	22.6	22.2	24.8
Communities of from			
2,500 to 10,000 inhabitants	13.9	14.0	16.5
10,000 to 25,000 inhabitants	17.4	18.3	21.1
25,000 to 100,000 inhabitants	20.2	20.0	23.0
100,000 to 500,000 inhabitants	22.1	23.8	27.4
500,000 or more inhabitants	33.6	31.1	36.2

(a) Census of 1910, Vol. I, p. 173.

It will be noted that, for all urban communities and for each of the groups included in the table, the proportion of foreign born whites was lower in 1900 and in 1910 than in 1890. For the urban communities as a whole, and for two of the five groups of cities, the proportion of foreign born whites was slightly higher in 1910 than in 1900, but, as the native born persons in the population everywhere outnumber the foreign born, the figures do not mean, in any instance, that the numerical increase in the foreign born has been greater than the numerical increase in the native born.

Natural Increase.—The natural increase of population in American cities from 1900 to 1910 is not known from direct statistical evidence as in other countries, but can be approximately determined by estimate. A method for determining the natural increase of the population of the United States is indicated in the Census of 1910.† The natural increase for

* Thus, if to a population of 1,000 persons, of whom 750 were native born and 250 foreign born, there were added 100 native born and 100 foreign born, the proportion of foreign born would advance from 25 per cent. to 29 per cent. If, on the other hand, 100 native born persons and 100 foreign born were added to a population of 1,000 persons of whom 400 were native born and 600 foreign born the proportion of foreign born persons would fall from 60 per cent. to 58 per cent. Clearly, the effect of increments to different classes of the population on the proportion of these classes to total population depends, not only on the numerical size of each increment, but on the proportion which the class is of the total population.

† Census of 1910, *Abstract*, p. 78.

the country as a whole equals, approximately, the difference between the aggregate population of 1900 and that of 1910, less the number of foreign born whites enumerated in 1910 who had arrived in this country subsequent to 1900. The total population was 75,994,575 in 1900 and 91,972,266 in 1910, and the number of foreign born whites enumerated in 1910 who came to the United States after 1900 was 5,313,659.* Hence the increase not due to immigration was, approximately, the difference between 91,972,266 less 5,313,659 and 75,994,575, or 10,664,032. The rate of natural increase, figured on the total population for 1900 was, accordingly, 14.0 per cent. What is the relation between this rate for the population as a whole and the rate of natural increase for urban population? Is natural increase more or less rapid in the cities than in the country as a whole, and how great is the difference?

In order to answer these questions it is necessary to consider deaths and births in the whole population and in city populations. While there are no mortality statistics for the whole population of the United States, death rates are available for the registration area and for registration cities having, in 1910, 10,000 or more inhabitants. The crude death rates for these areas should not be applied to the total population of the country and to the total urban population without making corrections for differences in the proportion of Negroes in the several population groups.† In all large populations the death rate for Negroes is much higher than the death rate for whites. Reasonably satisfactory results may be obtained by applying the death rates for colored persons‡ and whites,

* Census of 1910, Vol. I, pp. 1019–22. The figure presented is the sum of the reported number of foreign born persons enumerated in 1910 who came to the United States after January 1, 1901, and the estimated number of persons who came in from June 1, 1900, to January 1, 1901. The estimate was made by the method employed in determining the number of foreign born persons of less than 10 years' residence in the urban population and described above, p. 658. A maximum of 5,376,635 and a minimum of 5,250,683 were computed, and it was assumed that the actual number lies midway between these figures. The results obtained in the application of the estimate will not be appreciably affected by any error that may arise through this assumption.

† It would not be necessary to attempt to correct for differences in age distribution, even were it possible to do this, as there is no reason to believe that the relation between ages in the total population and ages in the total urban population differs greatly from the relation between ages in all registration territory and ages in registration cities.

‡ In the mortality statistics of the Bureau of the Census the returns for Negroes are not distinguished from the returns for the rest of the colored population. Negroes, of course, constitute a very large proportion of the total colored population.

respectively, in the registration populations, to corresponding groups in the whole population. In the total registration area the death rate for whites in 1910 was 14.6 per 1,000; that for the colored population was 24.2 per 1,000.* The number of whites in the total population of the United States in 1910 was 81,731,957 and the number of colored persons was 10,240,-309.† Hence, the number of deaths among the whites must have been approximately 1,193,287; and the number in the colored population, 247,815. The total number of deaths was, then, 1,441,102, and the crude death rate for the country's total population, 91,972,266, was, on this basis, 15.7 per 1,000.

In registration cities in 1910, the death rate was 15.5 for whites and 26.5 for the colored population.‡ As there were 39,831,913 whites and 2,791,470 colored persons in urban communities in 1910,§ the deaths among whites numbered approximately 617,395 and the deaths among colored persons approximately, 73,974. Hence, the total number of deaths for urban populations was about 691,369, and the total urban population being 42,623,383, the death rate was 16.2 per 1,000. It will be assumed that 16.2 per 1,000 is the approximate death rate for all urban communities and that 15.7 is the death rate for the total population, both urban and rural, for the decade 1900–1910.

In the absence of trustworthy birth registration statistics the number of births occurring can be estimated by studying the proportion of native born children under five years of age in the population, and the death rates affecting young children.‖ In 1910 there were 10,483,695 native born children under five years of age in the total population of the United States, and 4,120,665 in the population of all urban com-

* Bureau of the Census, *Mortality Statistics*, 1910, p. 67.

† Census of 1910, *Abstract*, p. 77.

‡ Bureau of the Census, *Mortality Statistics*, 1910, p. 67.

§ Census of 1910, *Abstract*, p. 92.

‖ The migration of children under five years of age from country to city constitutes a possible source of error in estimates based on the statistics referred to. Among young children the amount of migration is, however, relatively small, and the movement from the country to the city must be balanced, at least in part, by a movement from city to country. It is probable that the influence of this factor is very slight indeed.

munities.* These figures do not represent the number of children born in the five-year period preceding the date of the Census, but the number born in such a period who survived to the end of the period. As the death rate among young children is everywhere high, the number of births must have exceeded considerably the number of survivors.† Is it possible to determine the approximate number of births for the country as a whole and for the cities?

In 1900 the death rate for children under five years of age in the entire registration area was 51.9 per 1,000, while that for the corresponding group in registration cities was 58.0 per 1,000. ‡ These 1900 rates are the most recent available for the whole registration area and for all registration cities, but rates are reported for 1911 for the entire population of the registration states and for the 50 cities having, in 1910, 100,000 or more population. Registration states may be regarded, for our purposes, as representative of the whole population. And as the 50 largest cities, while numbering a small fraction of the total number of registration cities, embrace a very large proportion of the total population of such cities, the rates reported may probably be regarded as representative city rates. In one respect the 1911 figures are superior to the 1900 figures—separate death rates are given for children under one and for children of from one to five years of age. The distinction is an important one, as mortality is always much greater in the first year of life than in the years immediately following. In 1911, for children under one year, the death rate in registration states was 112.9 per 1,000, and the average (unweighted) death rate for the 50 largest cities was 133.8 per 1,000; for children from one to five the death rate in registration states was 11.8 per 1,000, and the average (unweighted) death rate

* Census of 1910, Vol. I, p. 413. The figures given are, in fact, the returns for native born whites and for Negroes under the age of five years. Foreign born Negroes are included, while native born colored persons other than Negroes are not included, but as the number of persons under five years of age in either of these classes is very small, and as the inclusions and the exclusions tend to balance each other, the figures cited represent, with substantial accuracy, the numbers of native born children under five in the total population and in the urban population.

† The Bureau of the Census regards the birth returns as approximately correct only in those areas for which the reported number of births in a year exceeds the reported population under one year of age by 10 per cent. or more. Bureau of the Census, *Mortality Statistics*, 1911, p. 25.

‡ Bureau of the Census, *Mortality Statistics*, 1911, p. 18.

for the 50 cities was 14.6 per 1,000. * These rates corroborate the 1900 rates already cited—both sets of figures show higher mortality of young children for the cities than for the general population. The number of births which is followed by 1,000 survivors must therefore be greater in cities than in the country as a whole. "How much greater?" is the question.

If the 1911 rates cited are applied to the entire population of the country and to the entire urban population under five years of age for the years from 1905 to 1910, and if it be assumed that the death rates were the same at each age from one to five years, the number of births per 1,000 survivors under five years of age was 1,127 for the country as a whole, and 1,153 for urban communities.†

* Bureau of the Census, *Mortality Statistics*, 1911, p. 16.

† To derive the number of births from the known death rates the following method was adopted: If in the cities the death rate for children under one year of age was 133.8 per thousand, this means that there would be 133.8 deaths in a year in a group of children born on a given date whose number averaged, for the year following that date, 1,000. Assuming that the deaths were distributed evenly through the year, and hence that half occurred before the group was reduced to the average stated, the number of children at birth must have been 1,067, and the number of survivors at one year of age, 933.

If we knew the number of survivors exactly one year old in the populations with which we are dealing, we would need to go no further, for we could assume that the births were to the survivors one year old in the ratio of 1,067 to 933. But our only available figure for cities is the number of children under five years of age, while the best figure available for the country as a whole, the number of children under one year of age, represents a group whose average age cannot exceed and probably falls considerably short of six months, rather than a group of children exactly one year old. For these reasons, and as information as to the number of children under one year of age is, at best, uncertain, further computation is necessary.

The death rate in cities in 1911 for children from one to five years of age was 14.6 per thousand. If the 933 survivors at one year of age, determined in a preceding paragraph, were exposed, during the following year, to the death rate of 14.6 per thousand, the number of survivors at two years, determined by the process already demonstrated, would be 920. Continuing to apply the rate of 14.6 per 1,000 until the age of five years is reached, we obtain the following figures:

Year.	Death Rate.	Population at		
		Beginning of Year.	Middle of Year.	End of Year.
First	133.8	1,067	1,000	933
Second	14.6	933	926	920
Third	14.6	920	914	907
Fourth	14.6	907	901	894
Fifth	14.6	894	888	882

Further application of the method by which the foregoing table was derived shows that the number of survivors half a year from the beginning of the period would be 967; the number 1½ years from the beginning, 926; the number 2½ years from the beginning, 914; the number 3½ years from the beginning 901; and the number 4½ years from the beginning, 888.

In estimating the number of births in city populations, and in the whole population, it will be convenient to regard children under five years of age on April 15, 1910, as made up of five groups. One group consists

On this basis, as the number of children under five years in 1910 was 10,483,695 for the country as a whole, and 4,120,665 for urban communities, the number of births in the 5 years preceding was 11,815,124 for the entire country, and 4,751,126 for the cities; and the number of births per year was, approximately, 2,363,025 for the United States and 950,225 for the cities. The estimated population of the United States for the middle of the five-year period was 87,977,843; and the estimated population of the cities 39,869,949.* Hence the

of children who, having been born between April 15, 1905 and April 15, 1906, are from four to five years of age, their average age being approximately, four and one-half years. It is clear that the children of this group have been exposed to the death rate of children under one year of age for one year, and to the death rate of children under five years of age for 3½ years. Another group consists of children born between April 15, 1906, and April 15, 1907, who are from three to four years of age and whose average age is three and one-half years. The children of this group have been exposed to the death rate for children under one year for one year, and to the death rate for children from one to five for 2½ years. The third, fourth, and fifth groups are made up by the same method. Applying the principles discussed above to city populations in 1910 the essential facts and results for the five groups are as follows:

Group.	Children Born Between	Average Age, Apr. 15, 1910, in Years.	Years Exposed to Death Rate of.		Births.	Survivors, Apr. 15, 1910.
			133.8	14.6		
1	Apr. 15, 1905, and Apr. 15, 1906	4.5	1.0	3.5	1,067	888
2	Apr. 15, 1906, and Apr. 15, 1907	3.5	1.0	2.5	1,067	901
3	Apr. 15, 1907, and Apr. 15, 1908	2.5	1.0	1.5	1,067	914
4	Apr. 15, 1908, and Apr. 15, 1909	1.5	1.0	.5	1,067	926
5	Apr. 15, 1909, and Apr. 15, 1910	.5	.5	..	1,033	967
Total					5,301	4,596

In other words, 5,301 births during a period of five years resulted in 4,596 survivors at the end of the period, or every 1,000 survivors represent 1,153 births. A similar mode of calculation is followed for the country as a whole with the result given in the text.

For these calculations we are far from claiming any absolute accuracy. They are designed to establish some relationship between the country as a whole and city population as respects the frequency of births. The assumption that the death rate for children from one to five applies at all ages within these limits is only approximately correct, as mortality is everywhere greater in the second year of life than in the years that immediately follow. It will be seen, however, that the computations based on the death rates cited in the text are used, not to ascertain the relation between population and births, but rather as a means of comparing the ratio between the number of children born and the number surviving at the end of a five year period in the country as a whole, with the corresponding ratio for cities. It is believed that for this purpose the assumptions are valid; that the results obtained will not differ essentially from and will be as useful as any results that might be obtained through further manipulation of the rates, or through the application of more complicated mathematical processes.

* Census of 1910, *Abstract*, p. 55.

number of births per 1,000 population for the country as a whole was approximately 26.9 and the corresponding figure for the cities 23.8.

The death rate for the total population has been fixed at 15.7 per 1,000; that for city population at 16.2. As in cities the birth rate is lower and the death rate higher than the country as a whole, the rate of natural increase of city populations must be materially less than the rate of natural increase of the whole population. The difference may be measured, approximately, by comparing birth rates with death rates. For every 1,000 persons in the total population there were 26.9 births each year and 15.7 deaths; the births exceeded the deaths by 11.2 per 1,000, and this last ratio represents the approximate natural increase. In city populations, on the other hand, there were 23.8 births each year and 16.2 deaths per 1,000; hence the natural increase for city populations was 7.6 per 1,000.

This last figure is not presented as a measure of the actual annual increase in city populations. Because of the many assumptions involved in the computations the use of the ratio for such a purpose would be imprudent. The ratio is offered, in connection with the corresponding ratio for the country as a whole, to show the relation between natural increase for the country as a whole and the natural increase of city populations.

An annual natural increase of 7.6 per 1,000 is 67.9 per cent. of a natural increase of 11.2 per 1,000. It has been seen that the natural increase of the total population from 1900 to 1910 was 14.0 per cent. The natural increase in city populations for the ten-year period should be about 67.9 per cent. of 14.0 per cent., or 9.5 per cent.

The urban population in 1900 was 31,609,645. A gain of 9.5 per cent. would amount to 3,002,916. As the total increase in urban population from 1900 to 1910 was 11,013,738, the fraction of this gain due to natural increase was, on the basis indicated, 27.3 per cent.

It is obvious that the figures just given do not represent the natural increase with exactness. Mention has already been made of the assumptions on which the various computations are based, and of the possible influence of the migration of

children under five years of age on the results. If, as is quite probable, the migration of young children from country to city exceeds the corresponding migration from city to country, the urban birth rate, the urban rate of natural increase, and hence, the proportion of urban gain due to natural increase, as estimated, are slightly too high. The figures given represent not the exact, but the approximate gain from natural increase. While it does not seem advisable to attempt to fix definite limits within which the true figure is to be found, the approximation is believed to be a fairly close one.

Migration from Country to City.—Of the three sources of urban growth two have now been considered—alien immigration and natural increase—and figures and estimates have been presented. As to the contribution made by the third source, migration from country to city, no direct evidence is available. It is clear, however, that whatever portion of the total increase is not traceable to one of the first two sources, must arise from the third. As has been seen, the total urban gain from 1900 to 1910 was 11,013,738. The maximum contribution made by alien immigration has been fixed at 4,090,514, while the gain from natural increase has been estimated at 3,002,916. If these figures may be relied upon, the minimum gain due to migration from country to city was 3,920,308 (the difference between 11,013,738 and the sum of 4,090,514 and 3,002,916), or 35.6 per cent. of the total increase. And as the minimum contribution of alien immigration has been estimated at 3,308,091, the maximum contribution of migration from country to city may be placed at 4,702,731 (the difference between 11,013,738 and the sum of 3,308,091 and 3,002,916), or 42.7 per cent. of the total gain.

Summary and Conclusions.—The estimates presented in the foregoing paragraphs are repeated in graphic form in the accompanying diagram. The increase in urban populations from 1900 to 1910 was 11,013,738. This increase has been distributed as follows: Alien immigration, from a maximum of 4,090,514, or 37.1 per cent. of the total increase, to a minimum of 3,308,091, or 30.0 per cent. of the total; natural increase, 3,002,916, or 27.3 per cent. of the total increase; and migration from country to city, from a minimum of 3,920,308,

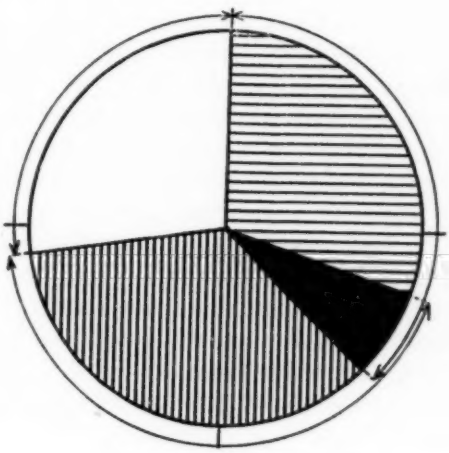
or 35.6 per cent. of the total increase, to a maximum of 4,702,-731, or 42.7 per cent. of the total.

In view of the estimates and assumptions involved, the results of this study are to be accepted with a certain reserve. The Census figures seem to show that not over three eighths of the gain in urban population from 1900 to 1910 was due to alien immigration. As to the other matters considered the evidence is less definite. It is believed, however, that the statistics presented support the general conclusion that the part of the urban gain due to alien immigration probably did not fall short of three tenths of the total, that the contribution made by natural increase amounted to slightly over one fourth of the total, and that the gain from migration from country to city amounted to between one third and four ninths of the total gain. The inference seems permissible that alien immigration was not, in any sense, the preponderant source of urban growth. There is reason to believe that less than half the total gain arose from this source, and that the most potent single factor was migration from country to city.

URBAN INCREASE FROM 1900 TO 1910
In numbers, 11,013,738 persons

Natural increase: 27.3 per cent.

Alien immigration: maximum, 37.1 per cent.; minimum, 30.0 per cent.



Migration from country to city: maximum, 42.7 per cent.; minimum, 35.6 per cent.

A STUDY OF THE CAUSES OF INDUSTRIAL ACCIDENTS.

By Gustavus Myers.

Since the adoption by twenty-four states within the last few years of workmen's compensation laws, the opportunities for securing data as to the frequency and causes of industrial accidents have been greatly increased. Previous to the passage of those laws and of the appointment of commissions to administer them, there was no system in force under which any state received and arranged reports of all accidents taking place in industrial establishments, and this was true of fatal as well as non-fatal accidents. Occasional investigations might be made here and there by special official bodies, but there was no provision for permanent inquiry and report.

In at least two branches of the subject—those pertaining to accidents on railroads and in mines—record was kept of accidents, but this was done by federal officials; in the one case by the Interstate Commerce Commission, in the other by the Bureau of Mines. As for accidents in purely industrial concerns, nothing even approaching an adequate record was kept, and there were neither requirements nor facilities for keeping any.

When, however, the passage of workmen's compensation laws brought permanent commissions into existence, there were created continuing agencies among the functions of which were the assembling and reporting of all necessary data. Necessarily, each of these commissions, operating under differing laws, produces an absence of uniformity, and this applies to specific provisions of law as well as to methods. Some of the commissions will make exhaustive reports while others give no detailed statistics, but so far content themselves with reporting merely the main outline of facts. In some states a system of the most thorough reporting and tabulation has been put in operation under the supervision of skilled statisticians; in other states this system has not yet been introduced.

Nevertheless, making full allowance for these deficiencies, there is already supplied a mass of data affording certain authentic information. If there is any one phase of the matter of industrial accidents long a prolific source of conjecture, contention, and extravagant assertions of one kind or another, it has been that regarding the factors causing them. What proportions are due to inherent risks of industry, and what to personal fault? Approximately what percentage is chargeable to employers, and what to employees? To what extent do unsafe machinery, lack of proper safeguards, flying objects, perilous speeding up, and other factors, on the one hand, and on the other, personal carelessness, enter into the causative nature of industrial accidents? Upon one or more or all of these questions various assumptions have been and are still being made. The data at hand in the official reports are manifestly not conclusive of the situation in the United States as a whole. Much of it, too, is incomplete and requires further elucidation. Still, there remains a valuable body of reliable statistics containing significant essentials well worthy of consideration.

When, in 1908, Frederick L. Hoffman, basing his estimate upon the data then available, conservatively placed the number of deaths due to industrial accidents at 30,000 to 35,000 a year, and casualties of all kinds in the United States at 2,000,000 annually, the assumption was advanced that at least 50 per cent. of these mortalities and injuries "were the direct result of the occupational risk." These figures, published in Bulletin No. 78 of the U. S. Bureau of Labor, September, 1908, attracted widespread attention. In Bulletin No. 157, issued by the U. S. Bureau of Labor Statistics, in March, 1915, Mr. Hoffman concludes, after an exhaustive consideration of the returns, that "There are approximately 82,520 deaths per annum in the United States, from accidents due to all causes, and that of this large number of deaths some 25,000 may safely be assumed to represent the loss of life directly due to occupational activity, chiefly in connection with the carrying on of dangerous industries, all of which are typical of the economic necessities of modern life." The estimate by Carl M. Hansen, Secretary of the Department of Accident Preven-

tion, Workmen's Compensation Service Bureau, is somewhat different. In an address recently delivered before the National Association of Cotton Manufacturers, Mr. Hansen estimated that from 40,000 to 45,000 wage workers were killed by accidents in the United States annually. The Massachusetts Industrial Accident Board has placed the number of workers in the United States killed by accident yearly at 75,000 and the number of injured every year at 3,000,000. Estimates may vary, but the number killed and injured annually is self-evidently enormous.

Is the old assumption that about one half of these casualties are due to risk of industry practically correct? Is it an exaggeration or an under estimate? Examining the reports of the various state commissions administering workmen's compensation laws with respect to this particular inquiry, we get a scattering of some definite results based upon such casualties as have been reported.

The New York State Workmen's Compensation Commission began actual operations on July 1, 1914. The first annual report contains no statistics on the causes of the accident cases passed upon by the Commission, but the promise is held out in this report that "the commission will maintain a small but well organized statistical department which will analyze claims to discover the causes of accidents, and by promulgating the information thereon, offer a constant incentive to employers to adopt safety methods and devices, on the theory that it is better to prevent an accident than to compensate the losses arising therefrom." Up to January 1, 1915, the following number of injuries were reported, awards allowed, and claims pending:

Number of notices of injury filed by employers	130,723
Number of claims received from employees	22,221
Number of claims in which initial awards were allowed	15,218
Number of claims in which subsequent awards were allowed	3,712
Total number of awards allowed	18,930
Number of claims disallowed	982
Number of claims pending	2,707
Number of completed claims set for hearing	2,314

No figures are given for the number of cases having fatal results. The report comments that although more than 130,-

000 workmen were injured during the 7 months from July 1, 1914, to January 31, 1915, only 22,221 claims for compensation were made. The principal reason for this disparity, it says, is that the law allows compensation only for such injuries as result in disability for more than fourteen days. Another reason was that many of the notices of injury applied to persons who were not in employments covered by the law; and a third reason is the fact that some reported injuries were sustained prior to July 1, 1914, and were therefore not compensable.

Although further reports must be awaited giving detailed statistics of accident causes in New York State, yet there is one vital fact already available from the records of the Legal Department of the New York State Workmen's Compensation Commission, throwing much light upon the mooted question of personal negligence. In view of the provisions in the New York Workmen's Compensation Act making intoxication a cause of exclusion of awards, it is important to inquire into the results. The Legal Department says that there were but a very small number of cases—perhaps not more than a hundred in a total of 18,930 awards allowed, in which the question of intoxication was raised by either the employer or insurance carrier, and that in not a single case did the Commission decide that the injuries were due wholly to intoxication, nor was a single claim disallowed on the ground of intoxication. It is evident that this element so frequently alleged as a fertile cause of accidents was not observable in the investigations made in New York State. The hope may be expressed that in its next report the New York State Workmen's Compensation Commission will present facts as to what causes do produce accidents, and also give what is lacking in its first report, the sex and ages of the total killed and injured, and months, days, and hours when the injuries happened.

The reports of the Commissions of certain other states likewise give no positive statistics on the causes of accidents, but merely register the aggregates of claims submitted and passed upon.

The Connecticut Board of Compensation Commissioners commenced active operations on January 1, 1914. Up to

November, 1914, there were reported in Connecticut 18,054 accidents, of which, the Commission reports, a very large number either did not incapacitate the injured employee from labor at all, or if at all, for periods of less than two weeks. The number of compensation agreements voluntarily entered into by employer and employee and approved by the Connecticut Commission, amounted to 3,444.

The Michigan Industrial Accident Board employs no statistician, explaining that it has no funds for the purpose. The total number of accidents reported during 1914 to the Michigan Board was 33,315, of which 290 resulted fatally. Of the 33,315 cases, nearly 20,000 did not receive compensation, for the reason that the disability continued for less than two weeks, which is the waiting period under the law. Under the rules of the Michigan Board, no case is reported unless the injury is sufficiently severe to cause total disability of at least twenty-four hours, or which results in the loss of a member or death.

The first annual report of the Texas Industrial Accident Board is similarly meager in statistics. The Employer's Liability Act in Texas became effective on September 1, 1913. During the fiscal year ended August 1, 1914, there was a total of 18,888 injuries reported, 81 of these injuries resulted in death. During this period 4,000 injured employees received compensation, and an aggregate of 7,091 received either compensation with medical aid, or medical aid only. The total number of employees of 2,844 subscribing employers in Texas, on September 1, 1914, was 95,808. Subscription to the Texas Act is not obligatory on employers, and from its provisions are exempted domestic servants, farm laborers, employees of operators of railways as common carriers, laborers engaged in working for cotton gins, and employers of less than 6 employees. The Texas Industrial Accident Board recommends that the Act be so amended as to apply to all employees excepting only domestic servants, farm laborers, and railway employees. The first report of the Texas Industrial Accident Board is concerned largely with pointing out evils that have developed, with suggestions for changes, and explanatory statistics of accidents are excluded. One of the many complaints made by this Board is of especial interest. It declares that "in a

very large number of cases it has come to the knowledge of the Board that attorneys have been employed at a cost to the employees of one third and, oftener, one half of the compensation to which they were entitled, and secured by assignments of an interest in the compensation. . . . Instances have become known to the Board where the contract between the attorney and the employee also provided that all compensation shall be paid directly to the attorney." The Board asks for authority to declare invalid all such assignments or transfers of compensation by employees.

The first year of reports under the Workmen's Compensation Act in Minnesota was 1913–1914. During this year, according to the report of the Minnesota Department of Labor and Industries, there were 149 fatal accidents and 12,084 non-fatal accidents. Of these 211 were females, two of whom were injured fatally. The following table shows the industrial accidents in Minnesota by industries in 1913–1914:

Industry.	Fatal.	Non-fatal.
Railroad shops	2	809
Mining	42	2,252
Lumber and U. W.	22	2,428
Contracting	21	1,730
Public utilities	9	508
Agriculture	12	203
Flour manufacturing	5	313
Foundries and machinery	9	1,093
General manufacturing	10	892
Mercantile	6	882
Miscellaneous	11	974
Totals	149	12,084

A striking fact dealing with the question of frequency of accidents is that the non-fatal accidents in Minnesota increased from 5,442 in 1912–1913 to 12,084 in 1913–1914, and the totals of fatal and non-fatal accidents from 5,578 to 12,233. This increase is explained by the activity of the state's inspectors in calling the attention of the employers to the accident report law. The ages of 7,114 injured employees in all industries in Minnesota in 1913–1914 were:

Age Groups.	Number.	Per Cent.
14 to 16 years	45	.65
17 to 21 years	904	12.70
22 to 30 years	3,062	43.00
31 to 40 years	1,762	24.80
41 to 50 years	918	12.90
51 to 60 years	320	4.50
60 years and more	103	1.45
Totals	7,114	100.00

A companion table in the report shows that of a total of 5,701 injured, 15.25 per cent. were occupied less than one week at the work on which they were injured; 14.65 per cent. less than one month; 37.50 per cent. from one month to one year; 22.20 per cent. from 1 year to 5 years; 6.50 per cent. from 5 to 10 years; and 3.90 per cent. 10 years and more. Evidently inexperience is a very considerable factor in causing accidents. Although Part III of the 1914 Report of the Minnesota Department of Labor and Industries gives 22 tables of statistics, none of them, unfortunately, covers the specific causes of accidents. In the "Minnesota Bureau of Labor Bulletin on Industrial Accidents and Workmen's Compensation," Don D. Lescohier, Expert of the Minnesota Bureau of Labor, assigned 71.6 per cent. of industrial accidents to hazards of industry, and 5.2 per cent. to contributory negligence. In another article, published in June, 1911, Mr. Lescohier stated that Minnesota employers reported that fully 60 per cent. of all accidents were due to dangers inherent in industry," a conclusion almost identical with that reached by the "Minnesota Bureau of Labor in a previous publication." Mr. Lescohier declared that more than 50 per cent. of the accidents that occur were certainly preventable. Continuing, Mr. Lescohier pointed out that "the principal causes of accidents found responsible in whole or in part for the 38 per cent. of the accidents attributed to the workmen, were youth, ignorance of the English language, incompetence, carelessness, ranging all the way from momentary inattention or forgetfulness to foolhardy recklessness, personal shortcomings, like deafness, or excitability and absorption in the work at hand which make the workman oblivious of approaching danger, fatigue, and nerve strain."

Such statistics as are given of the first year's operation of the Minnesota Workmen's Compensation Act seem to show that the great proportion of the cases open to compensation were not contestable on any ground. The large number of cases in which the workman was disabled for less than two weeks were not entitled under the law to compensation. Deducting these, left 3,634 cases subject to the compensation provisions. By June 30, 1914, the end of the fiscal year, all payments were made in 2,468 or 67.6 per cent. of the cases, and settlements were in process in practically all of the remainder.

The New Jersey Workmen's Compensation Law was enacted in 1911. Section 1 of this Act allows compensation "providing the employee was not guilty of negligence." Section III defines negligence: "For the purposes of this Act, wilful negligence shall consist of (1) deliberate act or failure to act, or (2) such conduct as evidences reckless indifference to safety, or (3) intoxication as the proximate cause of injury."

In the years 1911–1913 the total number of non-fatal accident reports received in New Jersey was 6,635, and in the following year 5,750. In the year 1912–1913, there were 233 fatal accidents reported. The New Jersey Employers' Liability Commission complains in its 1914 report of the great laxity in the reporting of accidents by employers. "This is evident," it says, "from the fact that while there are, according to the records in the Department of Labor, about 5,000 manufacturing employers in the state, we have only received reports from about 1,000."

This may reasonably be interpreted as an acknowledgment that there is probably a much greater frequency in accidents than is officially registered. Of 4,276 cases entitled to compensation in 1913, the greater part were settled promptly. The report of the New Jersey Employers' Liability Commission contains no statistics or explanations of the causes of accidents. It declares, however, that "the fact that of all the cases reported as compensated, 93.2 per cent. were settled automatically, *i. e.*, without reference to a court, speaks well for the law." This fact evidently shows that wilful negligence, whether in the form of intoxication or in the other ways de-

scribed in the Act, was so nearly absent as a factor as to be dismissed from consideration. The merits of such cases as were contested are shown in the further fact that of a total of 293 cases taken in 1913 to the Court of Appeals (deducting 12 cases dismissed or compromised before the final hearing), only three cases of the entire number were refused.

The reports of the Massachusetts Industrial Board, although not giving many statistics with reference to the question of personal fault, nevertheless present certain facts of value. From July 1, 1912, to June 30, 1913, there were in Massachusetts a total of 84,694 non-fatal accidents, of which 72,862 were insured. During the same period, the fatal accidents totalled 474 of which 290 were insured. Of the non-fatal accidents, 29,737, or 33 per cent. of the total number, were caused by hand labor, 11,375, or 12 per cent., by machinery peculiar to special industries, 8,417, or 9 per cent., were the result of falls of various kinds, 4,331, or 4 per cent., were eye injuries, and 102, or 0.1 per cent., were occupational injuries (diseases). The heaviest causes of fatal injuries were due to railroad equipment, falls, vehicles, hand labor, elevators, electricity, and street railways. As a factor entering into the causes of industrial accidents, the report states that "dusty trades, industrial poisons, and occupational diseases are responsible for an annual loss in the United States of $750,000,000, through needless diseases and disablements, and Massachusetts has her proportion of this enormous waste. The great majority of wage earners spend at least one third of every twenty four hours in the factory, mill, or shop. Conditions in many of them are such that the worker is unable to attain fullest efficiency by reason of the conditions which surround him, and this has a direct bearing upon the number of accidents or the quality of the output of the worker. . . ."

Massachusetts is one of the few states in which statistics have been officially gathered as to the time of accident happenings. The 1914 report of the Industrial Accident Board of that state gives these totals of the days on which fatal accidents happened during the year in the industries in that state:

Monday	72
Tuesday	90
Wednesday	76
Thursday	79
Friday	76
Saturday	63
Sunday	18

In view of the assertions frequently made that Monday is the principal accident day, due to the effects of "Sunday celebration," these statistics, showing results contrary to that view, are instructive. The statistics given for the year for non-fatal accidents for forty-one industries, transportation systems and occupations in Massachusetts are:

Monday	16,309
Tuesday	15,465
Wednesday	14,871
Thursday	15,014
Friday	15,295
Saturday	11,217
Sunday	1,523

Considered as an aggregate these figures would seem to show that more non-fatal accidents happened on Monday than on any other day. But a scrutiny of the figures applying to each industry reveals that in the woolen and worsted mills, rubber factories, print works, rope and cordage factories, and in other plants, there were more accidents on Tuesday and often on Tuesday, Wednesday, and Thursday, than on Monday. The Industrial Accident Board notes that "except for Saturday and Sunday, when a small number of employees are working, the daily frequency of accidents is very steady." So far as wilful negligence (including intoxication) may enter into the matter of personal fault, there is, judging from the returns, hardly any of it admixed with the causes of industrial accidents in Massachusetts. Of 156 cases contested by appeal to the arbitration committees or to the Courts, from July 12, 1912, to June 30, 1913, there were only four cases in which there was any charge of intoxication, and in only two cases were claims denied on that ground.

In Ohio the elective Workmen's Compensation law went into operation on March 1, 1912, and the later enacted, so-called compulsory law, on January 1, 1914. The 1915 annual report of the Industrial Commission of Ohio states that for the year ended November 15, 1914, there were 68,869 claims filed, 306 of them death claims. Of these, 58,317 had been disposed of by that date. Under the head of "Causes of Accidents," the only statistics given in the 1915 annual report are these:

Cause to which Ascribed.	Number of Accidents.	Per Cent. of Total.
Falling and shifting objects	19,606	36.7
Machinery	14,018	26.3
Hand tools and simple apparatus	5,231	9.8
Nature of material used or similar working conditions	4,900	9.2
Falls	4,774	9.0
Carrying, lifting, or handling great weights	1,196	2.2
Transportation on tracks	912	1.7
Transportation not on tracks	699	1.3
Animals	457	.9
Suffocation and asphyxiation	139	.3
Sunstrokes and heat prostration	107	.2
Intentional violence of fellow employee	41	.1
Intentional violence of persons not employees	34	.1
Not otherwise classified	1,254	2.3
Total	53,368	100.0

Further in the report, however, under the section describing the Board's inspection division's activities in workshops and factories, the emphasis is placed upon the pressing need of safeguarding machinery. After itemizing 26,662 inspections made, the report comments: "It will be noted from the above that a large portion of the work of the division during the past year was devoted to factory inspection, special attention having been given to the matter of safeguarding machinery and the prevention of accidents. Very commendable progress has been made along this line, there being a marked decrease in the number and the seriousness of accidents occurring in industrial establishments." There are various other remarks in the report on the steps taken to insure better and safer working conditions for the workmen in the industrial establishments and also in the mines of Ohio. The whole trend of this report seems to remove the larger number of accidents from the domain of personal fault and places the responsibility for

them upon lack of proper safeguards or other conditions outside of the control of the workers.

The Wisconsin Workmen's Compensation law is an elective one; by June 30, 1914, 12,500 employers, with about 250,000 employees, were under its provisions. Reports of all accidents, causing disability of more than 7 days, together with the cause and nature of the injuries, are required from employers. The Wisconsin law, it may be noted, penalizes intoxication 15 per cent. In the year ended June 30, 1913, a total of 8,224 accidents were reported to the Industrial Commission of Wisconsin, of which number 4,526 cases were reported as not being subject to compensation provisions. Of a total of 3,571 cases of accidents in establishments of private employers, 2,781 cases were at once settled and compensation was paid by those employers without an order of the Industrial Commission. This would clearly appear to argue that all of those cases were of so manifestly meritorious a nature, that no charge of wilful misconduct could be interposed as an objection to payment. Of the remainder of the 3,571 cases, many were cases in which compensation was not claimed, and in other cases the hearings were still open or the claims were pending.

During the year ended June 30, 1914, there were reported to the Industrial Commission of Wisconsin, 11,148 accidents. Of this number 10,127 accidents in establishments of private employers were under compensation, and of these, 8,090 cases were settled and compensation paid without any order of the Commission. In 1,386 claims the cases were still open; in other cases hearings were still pending, and in 777 cases compensation was not claimed. If the provision (in effect since June, 1913) whereby an employee injured because of intoxication should have his compensation reduced 15 per cent. was inserted on the supposition that drunkenness was a frequent cause of accidents, that theory has been anything but confirmed by the returns. The records of the Industrial Commission of Wisconsin show that in only 4 or 5 cases out of the 18,139 cases up to January 1, 1915, has the employer made any claim that the employee was intoxicated, and in only one case has the Commission found that the injury was caused by intoxication. In view of these returns, the question of intoxi-

cation is not to be seriously considered as a direct cause of industrial accidents in Wisconsin.

What, then, are the causes? The Industrial Commission of Wisconsin devotes may pages of its report to a description of the work it has done in placing safety-promoting information in the hands of employers. This information deals with the safeguarding of machinery. Numerous employers, the Commission announces, are adopting these safety suggestions. "Many companies have made very substantial reductions in accidents as compared with their records five years ago. For instance, the Fairbanks-Morse Manufacturing Company of Beloit, has reduced accidents 72 per cent.; the Chicago and Northwestern Railway Company over 30 per cent.; the Illinois Steel Company, of Milwaukee, 70 per cent.; the Bucyrus Company, of South Milwaukee, 46 per cent.; the A. J. Lindeman-Hoverson Company of Milwaukee, over 50 per cent.; and the Allis-Chalmers Manufacturing Company of West Allis, over 50 per cent."

Nevertheless, even with this widespread coöperation of many employers, violations of safety and sanitary laws on the part of other employers persist. Of a total of 2,496 establishments inspected in the year ended June 30, 1914, violations were found in 1,487. The most serious aspect of the accident situation, the Commission reports, is the large class of accidents where, in nearly every case, the use of a mechanical guard is impossible by reason of the circumstances. The following is a list of such accidents during the 31 months from September 1, 1911 (when the safety law went into effect), to April 1, 1914:

Danger Points.	Number of Accidents.	
	Total.	Average per Month.
Cranes and derricks	165	5+
Explosions	191	6+
Escaping steam	77	3−
Hit by flying nails and chips	623	20+
Hit by hoisted or moving objects	1,121	36+
Hit by vehicles, cars or trucks	583	19+
Hit by objects falling from piles	1,412	45+
Hit by falling trees or limbs	260	8+
All other hits	874	28+
Falls downstairs	123	4−
Falls from ladders	268	8−
Falls from scaffolds	374	12+
Falls from buildings	93	3+
Falls into excavations	87	3−
Falls from wagons, cars, etc.	569	18+
Falls from boxes, chairs, etc.	55	2−
Slipping or stumbling	1,073	35−
Falls into vats, pits, holes, etc.	96	3+
Falls from piles, poles or trees, etc.	120	4−
Falls from tramways and trestles	37	1+
Falls from runways, loading platforms, etc.	93	3+
Other falls	197	6+
Handling heavy objects	2,640	85+
Teaming and trucking	349	11+
Animal bites and kicks	188	6+
Hand tools and apparatus	1,403	48+
Stepping or kneeling on nails, etc.	900	29+
Other similar causes	513	16+
Total	14,480	467+

The Commission comments that it requires only a glance at these accident statistics to convince one of the impossibility of framing specific laws to prevent them without prohibiting most of the operations altogether, and says that the problem of prevention lies preëminently with this class of accidents.

The reports of the Industrial Commission of California give ample statistics and explanatory comment. In 1911, a law called the Roseberry Act, was passed, but it was recognized as merely a crude beginning. Its purpose was chiefly formative and educational. The Industrial Accident Board created by this Act, complained, in its annual report for 1912, of inadequate powers conferred upon it by the Act. For the year ending December 31, 1912, there were 10,835 accidents reported. These represented only the accidents causing disability of more than 7 days. Of the 10,835 accidents reported, 9,627 were tabulated; of these 2,547 were railroad accidents (of which 106 resulted in death and 83 in permanent disability), and 7,080 accidents in other industries causing 306 deaths and 451 cases of permanent disability.

Impressed by the great number of accidents, the California Industrial Accident Board urged in its report that, "Our statistics show that in California we kill four times as many as we should but California has done nothing in the way of safeguarding its working people against needless dangers. There are literally no laws requiring machinery to be made safe. If the legislature will give the Industrial Accident Board power and authority to make the employments and places of employment as safe as they reasonably can be made, it will undertake, within five years, to reduce by one half, the number of serious and fatal accidents that would otherwise take place, and greatly to diminish injuries of a minor character. . . . "

In 1913, there were 12,031 accidents in California tabulated. These were all accidents causing disability of more than 7 days. Of this number, 890 resulted in permanent injury, and 555 fatally.

The legislature, in 1913, enacted the Workmen's Compensation Insurance and Safety Act. Under this law, operative from January 1, 1914, the Industrial Accident Commission was created to supersede the Industrial Accident Board. The Commission formulated new rules and regulations regarding the reporting of accidents, requiring reports of every accident which disabled throughout the day or which required medical attention, and also reports from every employer in California, including domestic, farm, and casual labor, which branches previously had not been covered.

The latest published annual report of the California Industrial Accident Commission deals, as far as the year 1914 is concerned, with the first six months of that year only. During this period, 26,958 industrial accidents were reported, of which 14,589 were non-compensable cases. Of the 26,958 accidents, 25,991 were cases of temporary injury, 698 cases of permanent injury, and 269 were cases terminating fatally. There were really 291 fatal accidents, but the Commission explains that considering the difficulty of getting complete information in 22 cases it uses the number 269 in most of the analytical tables.

In a study of these accidents, the Commission says:

"Roughly speaking, the causes of accidents fall under two heads: Those accidents that are caused by some mechanical device that is driven by man or horsepower; the other large class is that caused by some form or condition of hand labor. The former class of accidents can be reduced in a large measure by protective devices; the latter, by a campaign of education that will teach the employees that it is bad to lose money and time, but it is worse to suffer pain and mutilation of the body." Of the 291 fatal accidents, the largest number, 48, occurred on general construction work; 38, on steam railways; 33, in the lumber industry; 29, in mining and smelting; 27, in agriculture; 23, in power and light manufacturing and distribution; 19, in wharfing and shipping; and the remainder in various industries. The Commission calls particular attention to the accident mortality in agriculture, and explains that machinery is used so extensively on ranches and in dairying and kindred pursuits, that serious mangling by a mowing or pumping machine is not infrequent. Working around dangerous animals is also a cause of injury or death, the Commission notes, as the returns show. The causes of the fatal accidents in California during the first six months of 1914, are thus given:

Causes of Fatal Accidents.

	Numbers.	
Falling, Rolling and Flying Objects		66
Falling rocks, limbs and pieces of timber	24	
Cave-ins	18	
Rolling poles from cars	15	
Unloading and moving objects in shop	9	
Collisions and Derailments		60
Run over by train or vehicle	28	
Hit by train or vehicle	19	
Collision of trains, cars and vehicles	9	
Run over by trains while boarding	2	
Run over by "skip" in mine	1	
Derailment of coaches	1	
Falls		57
Into unprotected skylights and from unprotected scaffolds, etc.	37	
Into shafts and from ladders	9	
Slipping and falling	5	
Due to collapse of staging	4	
Due to shock	1	
While jumping from train	1	

Dangerous Substances		48
Contact with live wires	22	
Gas explosions and blastings	10	
Poisoning gases	8	
Explosions of boilers and steam pipes	5	
Infections from nail wounds	2	
Squirrel poison	1	
Drowned		27
Machinery and its parts		11
Unprotected revolving shafts	3	
Unprotected belts and pulleys	2	
Unprotected circular saws	2	
Unprotected flywheels	2	
Unprotected gears	1	
Defective becket	1	
Elevators, hoisting apparatus, lines, etc.		10
Altercations		6
Animals		2
Cause unknown		2
Tool		1
Intoxication and falling into shaft		1
Total		291

It will be noted from the foregoing table that flying, rolling, and falling objects caused the largest number of deaths, and that unprotected places and apparatus were also a large cause. There is only one case of wilful misconduct, under the form of intoxication, noted. The causes of accidents in California resulting in permanent injury were, in general, the same, as follows:

Causes.

	Number.
Power-driven machines	250
Shopwork, handling heavy objects, flying fragments and falling bodies	251
Collisions, falls from ladders and on stairs, jammed in doors	86
Tools	62
Elevators, derricks, winches	59
Animals	9
Unknown	1
Total	698

Many of these accidents, especially to the eyes, the Commission says, could be avoided by very simple and inexpensive means. "It is generally thought," the Commission states, "that the major part of those killed and permanently injured are men who are old and clumsy, or who have grown careless with years. The contrary is true. Industry, like war, crushes the flower of its army. According to graph No. V, 254, or approximately 36 per cent. of those who received permanent injuries, were 20 years of age. No distinction of sex is recognized; but 12 girls and women are numbered among those who were crippled by machinery. The average age of those permanently injured was 34 years."

Of the 25,991 temporarily disabled in California during the first six months of 1914, the principal causes were:

Causes.	Number.
Hand labor	7,572
Falls	4,051
Falling objects	3,438
Eyes	2,109
Machinery	1,330
Nails	1,324
Burns and scalds	1,079
Vehicles	951
Infections	805

The causes of the remainder of the cases given in the table were animals, railroad-equipment, glass, saws, elevators, electricity, street railways, and various effects of power-driven machinery. Of the 3,959 injuries received in six months, in general construction, the report says that "the common hazard of general construction is poor staging quickly constructed, a one- or two-plank scaffold with no guards, lax rules governing the disposition of refuse lumber, bricks, etc., new stairways and openings left unprotected." The same hazards, the report states, were responsible for the 3,312 injuries to workmen, in six months, in the construction and operation of steam railways in California.

An instructive table, presented in the California report, is

that dealing with the frequency of non-fatal accidents occasioning temporary disability, by the day of the week. The 25,991 such accidents during the first six months of 1914 occurred by days as follows:

Sunday	1,339
Monday	4,431
Tuesday	4,236
Wednesday	3,919
Thursday	3,997
Friday	4,118
Saturday	3,874
Unknown	77
Total	25,991

These statistics show, like those of Massachusetts, a fair degree of daily uniformity in the frequency of accident occurrences. Tuesday's and Friday's lists are almost as large as Monday's, and on certain other days the number is not far behind. No substantiation is found in these returns for the extreme assertion so often made that the bulk of accidents happen on Monday and are the result of the use of alcohol on Sunday. The California report gives no interpretation of the figures, but the explanation offered by Dr. I. M. Rubinow in his volume "Social Insurance" has force. "The suggestion has never been offered," he says, "that changes of occupation occur usually at the end of the week and the new work is begun on Monday, and the lack of familiarity with the new machine or with the new place of work is a fruitful cause of accidental injuries. . . . "

The California Industrial Accident Commission notes with satisfaction that since January 1, 1914, 3,019 farmers, 484 employers of domestic labor, and 344 employers of casual labor have voluntarily accepted the provisions of the Compensation Act, bringing under its protection approximately 30,000 casual, domestic, and farm laborers. The report points out the frequent risks confronting these laborers in the performance of duty.

The Nevada Workmen's Compensation Act is, like that of

Michigan, elective, but compulsory as to public employees. By December 31, 1914, there were 813 employers and 10,709 employees under its provisions. The 1915 annual report covers 18 months, from July 1, 1913, the time the Nevada Industrial Commission began operations, to December 31, 1914. During this period there were 1,849 accidents, of which number 986 incapacitated the injured worker less than 2 weeks, and 53 fatal cases. Of the total number of accidents, 707 were compensatory. The greatest number of accidents—1,270—occurred in mining. The report gives no specific statistics or explanatory remarks throwing light on the causes of the accidents. It says, however, that very few claims were submitted which were without foundation, and that most of those without basis were filed under a misconception of the provisions of the law.

The annual report of the Industrial Insurance Department of the State of Washington gives a mass of itemized information, accompanied by many tables of statistics. The Workmen's Compensation Act in this state is now in its fourth year of operation. By September 20, 1914, there were approximately 9,980 firms and individuals, employing 176,420 workmen, under its provisions. From October 1, 1911, when the law went into effect, to September 30, 1914, there were 43,321 accidents reported, 974 of them fatal. Of the 43,321 accidents, 31,320 claims were passed for final settlement.

To what varying elements of fault were the bulk of these accidents due? The 1914 report gives this table of statistics for the fiscal years 1913 and 1914, considered with regard to the dominant factor in each case:

Fault.	Fiscal Year 1913.		Fiscal Year 1914.	
	Number.	Per Cent.	Number.	Per Cent.
Risk of trade	8,543	69.0	10,279	81.7
Workman's fault	951	7.8	906	7.2
Fellow servant's fault	303	2.4	399	3.2
Employer's fault	90	.7	31	.2
Foreman's fault	12	.1	18	.1
Third person's fault	30	.2	25	.2
Facts not ascertainable	2,451	19.8	928	7.4
Total	12,380	100.0	12,586	100.0

In its first annual report, that for 1912, the Industrial Insurance Commission of the State of Washington, under the sub-heading of "Intoxication," reported: "Framers of compensation acts in other states and of the Federal bills for railway employees engaged in interstate commerce have devoted considerable attention to intoxication as productive of work accidents. The records of this Commission do not show many cases of intoxication. In one instance, a section worker, while in an intoxicated condition, had evidently laid down on the track of a logging railroad, and lost an arm from being run over by an engine. In instances of reported intoxication the workman has denied it, although admitting having had a glass of beer or two or the like. The question is invariably raised 'what degree of intoxication should be necessary to either bar a claim or result in some penalizing reduction?' "

If intoxication did not enter as a causative factor, what did? The 1913 report, explaining that its figures were based as accurately as possible upon the reports of employers and employees, declared that 72.4 per cent. of all accidents were reported to have occurred under conditions where safeguards were not applicable, and that in only 22.8 per cent. of the accidents were safeguards considered applicable. The Commission systematically distributed information among employers as to safety protective apparatus and measures, and in May, 1914, began organizing safety committees in the various mills, factories, machine shops, and logging camps. The results, it announces, have been gratifying; in 1914 only 25.4 per cent. of all accidents were mechanical, compared with 32 per cent. in 1913. Of 3,200 mechanical injuries in the fiscal year 1914, there were 247 occurring on machines that were not safeguarded. The Commission points out that the laboring class in the State of Washington is drawn from all countries in Europe, and that in a majority of cases, the workmen are at first unable to understand the directions of the superintendent or foremen, "and are ignorant of the dangers of wearing loosely-fitting or torn clothing around moving machinery, as well as the hazards of the machines."

In the case of the 9,386 non-mechanical injuries in the State of Washington in the fiscal year 1914, the main causes are

the same as in certain other states. The greatest single factor was falling and moving objects, causing 2,726 injuries. Next came falls with a record of 1,882 accidents. Heat and electricity caused 306 accidents, and miscellaneous, 4,472.

Of the industries, lumbering, milling, etc., produced 5,957 of the total of 12,618 temporary total disabilities, likewise the largest number of temporary partial disabilities (101 in 174), also 745 of the 1,478 permanent partial disabilities, and 165 of the 350 fatal accidents. The Commission's 1914 report elucidates these facts. It says: "We wish to call the attention of the employers, engaged in the logging industry, particularly, to the hazards of defective lines and lead traps on blocks. In a great many cases parts of old defective cable are used to fasten the blocks, with the result that the fastenings break as soon as they are subjected to a heavy strain. A number of accidents, occurring in connection with logging railway operations, is due to lack of blocking in the frog and guardrails and the antiquated equipment in use. Devices which have been discarded by the railway companies years ago, as being too hazardous, are still being used on some of the logging railways."

These returns from the official reports of the Commission of a number of states present statistics the accuracy of which is open to no question. To present the facts concerning accidents on railways and in mines would necessitate much space, and would too greatly extend an article, already long; therefore, these branches of the subject must be left to a further article. The foregoing facts, however, may justify certain general conclusions.

One is that the assumption that at least 50 per cent. of all industrial accidents are due to inherent risks of industry is not overdrawn, but is a conservative statement of the facts. True, protective devices are being constantly introduced, but there still remains the large and dangerous field where safeguards are not applicable. And while the different commissions are actively pushing the campaign for safety apparatus, a new factor, apparently making for accidents, has been introduced in industry. This is the "speeding-up" system, compelling workers to labor at nerve-racking speed. The reports of the Interstate Commerce Commission show that excessive speed required is one of the greatest causes of accidents.

Evidently, the House Committee on Labor (63d Congress, 2nd Session), after taking much testimony on the subject of "efficiency systems," thought so, too; in the preamble of a bill forbidding the "speeding-up" system in government plants, "speeding-up" was condemned as productive, among other effects, of accidents. In the Army and Navy Appropriation Bill, passed March 4, 1915, Congress inserted a provision prohibiting the employment of the "speeding-up" system in government plants.

A second conclusion is that, although personal fault may, in its aspects of ignorance, carelessness, and inexperience, account for a given number of accidents, yet it is a very minor, almost a negligible factor, as far as wilful misconduct is concerned. The returns show that deliberate recklessness or intoxication is not frequent as a cause of accidents, and in fact is so exceedingly slight as not to require serious consideration in the analysis of the immense number of accidents occurring in the United States annually.

This conclusion seems to be further borne out by the statistics in the federal report dealing with the cases under the United States Workmen's Compensation Act of 1908. Of 406 contested cases in four years (in the total number of accidents, the majority of the claims of which were allowed) negligence or misconduct was alleged in 80 cases, and in only one case was intoxication charged, and that charge was not substantiated by the courts.

A third conclusion is that the number of accidents is much greater than has been usually supposed. The reports of a number of the commissions refer to the fact that they do not by any means receive reports of all accidents, and that their lists are but partial. In addition, the process of covering accidents in agriculture has only just been begun. This, hitherto, has been an entirely neglected field, and to a large extent is still. From the scanty statistics at hand, it is not even possible to make a conjecture what the approximate total in agriculture is. Rural regions present an entirely different social environment from that of cities, yet accidents occur there as in industrial centers, on railroads, or in mines, although what the proportion is remains a problem.

REVIEWS AND NOTES.

Economic Cycles: Their Law and Cause. By Henry Ludwell Moore. New York: The Macmillan Company, 1914. Pp. viii, 149. $2.00 net.

In his study of *Economic Cycles* Professor Moore has given added proof of the fruitfulness of the mathematical methods of curve fitting and measurement of correlation when applied to economic statistics. In his search for the law and cause of economic cycles he has subjected the available statistics of rainfall, crop yields per acre and total production, crop prices, pig-iron production, and general prices to rigorous examination, first, to determine the cycles if there be cycles, and second, to determine the degree of correlation existing between the various series of statistics beginning with rainfall and ending with general prices, the last named series being taken as the best barometer of the ebb and flow of business.

Professor Moore formulates the law of economic cycles as discovered in his investigation as follows: "The weather conditions represented by the rainfall in the central part of the United States, and probably in other continental areas, pass through cycles of approximately thirty-three and eight years in duration, causing like cycles in the yield per acre of the crops; these cycles of crops constitute the natural, material current which drags upon its surface the lagging, rhythmically changing values and prices with which the economist is more immediately concerned" (p. 149).

In judging the validity of the author's conclusion the statistical methods used are decisive. Professor Moore truly says that "the literature in which rhythmic phenomena are treated in a statistical way teems with fallacies and uncertainties. . : for the method frequently adopted of smoothing the data is so arbitrary that one is at a loss to know whether, after all, the alleged periodicity may not, in fact, be due to the process of smoothing; and, in addition, one is left in doubt as to whether an indefinite number of cycles other than the particular one deduced might not, with equal or greater probability, be obtained from the same data" (p. 7). The method selected in the present instance is that of fitting a multiple sine function to the data, called harmonic analysis. The reviewer knows of no method that better satisfies the requirements or is more rigorous than the one applied. The Pearsonian coefficient is used for measuring the correlation. This is, also, the best available method.

The study opens with an examination of the data of annual rainfall in the Ohio Valley for the period 1839-1910. There is no secular trend, but there is a cyclical variation which is closely described by a function (consisting of the first five terms of Fourier's series) showing periods of 33, 16.5, 8 and 4 years, with the 33 and 8 year periods most strongly marked. The function thus derived is found to fit, also, the rainfall data of Illinois, a section more representative of American cereal production

than Ohio, for the period 1870-1910. The coefficient of correlation for the two series of annual rainfall in Ohio and Illinois for 41 years is 0.600.

The relation of crop yields per acre to rainfall in Illinois is then investigated. The crops considered are corn, oats, hay, and potatoes, constituting 93 per cent. of the crop acreage and 96 per cent. of the crop value in 1912. Wheat is omitted "because both spring and winter wheat are grown in the state, and the statistics of their relative yield and price are not given in the published material for the long record covered in our investigation." The secular trend in the yield per acre, which is considerable only in the case of corn, is eliminated from each series. The figures thus obtained are correlated with monthly rainfall statistics of the same years. The months showing the highest coefficients of correlation for a given crop are combined and called the "critical period" for that crop. The coefficients of correlation for the rainfall of the critical period of corn and the "cycles" of corn yield per acre (*i. e.*, secular trend eliminated) is 0.589; for oats, 0.290; for hay, 0.620; for potatoes, 0.666. These high coefficients indicate that yield per acre is to a very great degree dependent upon the rainfall of the critical period. Of course, the coefficient merely tells us that the two series fluctuate together; common observation must be relied upon to designate the cause and the effect.

The data for the four crops are then combined to get indices of crop yield in general, allowance being made for the different degrees of fluctuation by using the respective standard deviations as the units of measurement. The general crop indices thus found are correlated with the mean effective rainfall of the critical periods. The resulting coefficient, $r=0.584$, shows that the yields of representative crops and rainfall are highly correlated.

The final stage of the first part of the investigation is reached in an examination of the accuracy with which the rainfall curve having 33 and 8 year cycles describes the crop yield per acre. Professor Moore recognizes that the rigorous method is to obtain the curve describing the crop yield independently and then compare the curve found with the rainfall curve. The laboriousness of the rigorous process caused him to use a substitute method, *i. e.*, to fit the function describing the rainfall cycles to the yield data. Since the yield data satisfy a reasonable test of fit the author concludes that "the yield per acre and the rainfall of the critical season are highly correlated; the rhythmical movements of the yield and of the effective rainfall may be accurately described by a compound cycle of 33 and 8 years with their semi-harmonics; and the yield curve reproduces the general characteristics of the curve of effective rainfall" (p. 55). This conclusion appears to be justified. It is an extension of the finding of Professor J. Warren Smith, Sectional Director of the U. S. Weather Bureau, who said in the 1903 Year Book of the Department of Agriculture: "If one knows the precipitation during the month of July over the great corn-producing district he can estimate the yield of the season very closely." Professor Smith's study, to which Professor Moore does not refer, covered the eight leading corn states for the period 1888-1902; average yield per acre was

compared graphically with the average precipitation in June, July, and August. In the Monthly Weather Bulletin for February, 1914, Professor Smith continued the study, this time using the Pearsonian coefficient of correlation. He found that for the eight states during the period 1888-1912 the yield of corn per acre and the rainfall in July gave a coefficient of 0.78. In an article on "Correlation of the Weather and the Crops" (*Journ. Roy. Stat. Soc.*, Vol. 70, pp. 5 *et seq.*), Mr. R. H. Hooker made a more refined study in which he measured the correlation between crops and (a) rainfall, and (b) accumulated temperatures above 42°, based on English data.

Demand curves for each of the four representative crops were found by correlating the percentage change in production each year in the United States, as compared with the production of the preceding year, with similar percentage changes in the prices per unit. The coefficients are, for corn, −0.789; for hay, −0.715; for oats, −0.722; for potatoes, −0.856. Parabolas of the third degree, $y=a+bx+cx^2+dx^3$, are fitted to the data, giving the laws of demand for each crop. The negative correlation coefficients indicate that the demand curves slope downward toward the right, so that "the amount demanded increases with a fall in price and diminishes with a rise in price." The reviewer has found similar demand curves to those found by Professor Moore. In contrast to agricultural products, the demand curve for pig-iron slopes upward toward the right; the correlation coefficient for percentage changes in production and in price being +0.537. The high negative coefficient found for each of the four crops proves that Mitchell was in error when he said: "The relations between physical production and pecuniary value are decidedly irregular with agricultural products." (Business Cycles, p. 239.)

But are price changes of each of the four crops in the United States as closely correlated (inversely) with changes in yield per acre as they are with changes in total production? They are; since the coefficients for price changes and changes in yield are, for corn, −0.815; for hay, −0.656; for oats, −0.718; for potatoes, −0.873.

The fluctuations in the yield per acre of the four representative crops in the United States correspond to the fluctuations in Illinois, the coefficients figured for annual differences ranging from 0.745 to 0.855.

But is the yield per acre of the four crops taken really representative of the yield of crops in general in the United States? Statistics of the yield per acre of nine crops are available for the period 1870-1911, including all the leading cereals, hay, potatoes, and cotton. Constructing a series of weighted index numbers of the yield of the nine crops and correlating with a similar series constructed for the four supposedly representative crops the extremely high coefficient resulting, 0.960, assures us that the four crops are really representative.

Professor Moore next considers the question of the association of the fluctuations in yield per acre of the nine crops and the fluctuations in the volume and activity of trade and industry. Pig-iron production and general wholesale prices (Aldrich and Labor Bureau series) are used as business barometers. Instead of using the annual figures of crop yield, iron produc-

tion, and general prices the author uses three-year averages, e. g., the crop yield for 1895 is the average for 1894–5–6, that for 1896 is the average for 1895–6–7, etc. After eliminating the linear secular trend in each of the three series of three-year averages he obtains "cycles" of yield, iron production, and prices. The differences between the original annual figures and the three-year averages for corresponding years are called "deviations." The deviations of yield and (1) of iron production and (2) of general prices are positively correlated to a moderate degree.

The vital question now at issue is this: are the crop yield cycles (as defined in the preceding paragraph) matched by similar cycles in iron production and general prices? If so, do the cycles come in concurrent years or is there a lag in iron production and prices? Computation of the coefficients of correlation gives the following table:

Cycles of yield per acre of	Lag of (1) and (2) behind crop yield.					
	Same year.	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.
9 crops correlated with cycles of						
(1) Pig-iron production	0.625	0.719	0.718	0.697	0.572	.....
(2) General prices	.....	.....	.....	0.786	0.800	0.710

The conclusions drawn by Moore from the table of coefficients are that cycles in crops precede cycles in pig-iron production by two years and cycles in general prices by four years.

The differences between the coefficients are not large enough to warrant a conclusion as to the number years of lag for maximum correlation. Computation of the coefficients of correlation between first differences of the cycles would be, however, a test of greater significance. The radical drop of pig-iron production in a year of depression, as compared with the drop in prices on crops, and the averaging of non-homogenous years, *e.g.*, two years of great activity and one year of great depression (for instance 1906, 1907, 1908), makes a conclusion based on the size of the coefficients between three year averages of doubtful value. In correlating three-year averages instead of the annual figures Professor Moore is really measuring the cumulative effects of three years of good or bad crops on business conditions as represented by iron production and prices. The coefficients for the annual figures and for first differences would have been more interesting and significant.

Statisticians and economists are deeply indebted to Professor Moore for his fine work in developing the statistical complement of pure economics.

Colorado College. WARREN M. PERSONS.

Some Aspects of the Tariff Question. By Frank William Taussig, Ph. D., Litt. D. Harvard University Press, Cambridge, 1915. Pp. 365.

Professor Taussig begins his exposition with a brief but sufficient statement of the theory of international trade and tariff restrictions on such

trade, covering some fifty pages. In the first chapter is discussed the effect of protective duties upon imports and domestic prices. In the second, attention is given to the argument for *Protection to Young Industries*. The third is devoted to a study of *The Principle of Comparative Advantage*. These chapters constitute Part I. In the rest of the book are considered in detail some of the principal lines of industry around which the tariff controversy has raged and which illustrate principles set forth in the introductory chapters: in Part II, Sugar; in III, Iron and Steel; in IV, Textiles.

In discussing the tariff on sugar, something is said of the effect of the remission of duty on sugar from Hawaii, provided for in the reciprocity treaty of 1876. It is pointed out that most of the supply still had to be got from less favored producers; that the price, therefore, did not fall because of the remission; that the United States Treasury lost and the Hawaiian planters gained by the arrangement. They were, in effect, included within the fold of the American protective system. The revolution in Hawaii, leading eventually to annexation, is attributed in large part to the desire of Hawaiian sugar interests for a permanent favored place in the American market, a desire stimulated by their temporary loss of protection under the McKinley tariff law.

The case of Hawaii illustrates the way in which external conditions may cause rearrangement of industry in accordance with the familiar principle of comparative advantage. The favored position of Hawaiian sugar in the American market made sugar production a comparatively advantageous industry, and tended towards exclusive devotion to this industry and to the importation of goods formerly produced in the islands.

The differential in favor of Cuban sugar, we should expect to redound wholly to the benefit of the Cuban producers, were it not that this sugar, together with that from other favored sources, constitutes such a large proportion of the total consumption in the United States. Under existing circumstances, however, it is thought that the actual burden on consumers has come to be, in recent years, somewhat less than the maximum duty, though remaining somewhat higher than the duties levied on the sugar from Cuba.

The study of the iron and steel industry, in Part III, gives opportunity for some interesting observations regarding the kinds of production in which Americans appear to have a comparative advantage. For example, it is pointed out in relation to the cutlery trade, that some kinds of cutlery are steadily imported, while other kinds are not imported at all. The latter are those made in great quantities of a single pattern; and it is where automatic machinery, interchangeable parts, standard patterns and mass production are possible, that Americans excel. On the other hand, cutlery of the non-standardized sorts is imported even over high duties.

Unlike many who have delved no more conscientiously into the detailed facts of industry, Professor Taussig does not believe that the *free trade versus protection* controversy can be settled by inductive argument. General reasoning from simple premises must first be appealed to and will remain

of primary importance. In this, the conclusion of Mill and the classical economists, he is, in the reviewer's opinion, entirely right. But the inductive study which he presents, and for which his claims are thus sufficiently modest, is none the less of great value. It serves to illustrate concretely principles usually stated in the abstract. And for many minds it is calculated to give emphasis to those principles and to bring conviction of their truth.

HARRY GUNNISON BROWN.

University of Missouri.

A CORRECTION.

In my note on "Mechanical Devices in European Statistical Work," in the QUARTERLY PUBLICATIONS for June, I stated that certain tabulating machines referred to were of the "improved Hollerith type, printing automatically, both sub-totals and totals." The phrase "improved Hollerith type" was a free translation of "new Hollerith" in the German source. The rest of the description was an inference from the statement in the same source that the "old Hollerith" machines separately classified, "record by clock-dials and contain no provision for addition." I concluded from this (too hastily as it appears) that the new machines embodied the same improvements as those used in tabulating the thirteenth census of the United States (as indicated in footnote references). I wish to thank Mr. E. Davies of New York City, for the information that this inference was erroneous.

F. H. KNIGHT.

Cornell University.

FACTORS AFFECTING THE HEALTH OF GARMENT WORKERS.

The Eighth Report of the Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis has just appeared. It is a monograph of one hundred and four pages on "Factors Affecting the Health of Garment Workers," written by H. R. M. Landis, M.D., and Janice S. Reed. It is the result of a study of nearly a thousand workers in the garment industry examined while at their work. In the study three distinct types are included, the modern standardized factory, the contracting factory, and the sweatshop. The study includes the condition of the factories, the racial characteristics of the workers together with their physical condition, and the effect of trade processes upon this condition. The home environment of the workers is included, and tuberculosis and fatigue are given particular attention. The study deserves the attention of anyone who is interested in the health conditions in this trade. In the Appendix, copies of the inquiry blanks are included. These have apparently been drawn up with great care and might well serve as a model for future investigations along similar lines.

W. B. B.